1954
NEW ZEALAND

Twenty-eighth Annual Report of the

Department of Scientific and Industrial Research

Presented to the House of Representatives by Leave

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MINISTER'S STATEMENT

THE report of the Department of Scientific and Industrial Research for the financial year ended 31 March 1954 is presented herewith.

Mr F. R. Callaghan, I.S.O., M.A., F.R.E.S., retired at 31 March 1953. He joined the department on its formation in 1927, and was appointed Secretary in 1947. Mr Callaghan possessed qualities of sound judgment, leadership, and enthusiasm, together with wide knowledge, and he has done much to enhance the reputation of the Department, particularly in the field of agricultural research. I should like to take this opportunity of expressing my thanks and appreciation of his long and valued service to the Government.

The role and functions of Government have greatly extended in recent times. The Government is not only concerned, as it has always been, with the well-being of the people in a general sense, but today it finds itself actively participating in the promotion of the prosperity of the country. If it is to discharge such a function effectively it must have available to it the best possible information and advice on the many technical matters that arise. Government departments have therefore continued to make increasing use of the Department of Scientific and Industrial Research for scientific services.

Answers to the many day-to-day problems in the wide field of Government activity are usually required in the shortest possible time, and to be able to meet such demands it is necessary for the department to foresee future needs by maintaining a strong background of research work as a continuing part of its activities.

There should be no need to emphasize here the importance of scientific research in relation to the development of the country's natural resources and the promotion of efficiency and increased production in both primary and manufacturing industries. If the department is to meet its many responsibilities effectively and with true economy it is necessary to maintain a staff of the highest possible calibre, and to provide the best possible facilities for its work. I am concerned to see that this is done within the means available.

A new building for the Grasslands Division at Palmerston North is nearing completion, and the accommodation thus provided will, in considerable measure, meet the needs of this branch of the department engaged on work of first importance to agricultural industry. New accommodation has also been provided at Lower Hutt for three Research Associations adjacent to branches of the department. The new space, which is leased to the Research Associations, should greatly facilitate their work.

The Botany Division has for some time been greatly hampered in its work by inadequate accommodation in Wellington, but arrangements have now been made for the transfer of this branch to Christchurch, where a lease of a suitable building has been obtained.

I very much appreciate the work of the Council of Scientific and Industrial Research, and take this opportunity of thanking its members for the time and consideration they have given to the many matters with which it has had to deal. Following consideration by Cabinet of the recommendations of the National Housing Conference, I have

asked the Council to report on the part that research can play in relation to housing construction. A Committee of the Council has been giving consideration to this matter, and a report will soon be available.

In compiling the annual report of the department this year a substantial departure from precedent has been made. The annual report is intended to inform Parliament how the funds voted to the department have been used. With this in mind the Secretary's report has been extended, and attempts to state in non-scientific language the functions of the department and the major highlights of the year's activities. The technical reports of the various branches of the department have been eliminated, and in their place is given a list of the major projects under way in each branch, together with a list of papers published during the year. In future, branches will publish periodic reviews of their work, giving more detail than has been possible within the compass of the departmental annual report.

I am grateful to the senior officers of the department for the good quality of the advice tendered to me from time to time, and I am grateful to the members of the staff as a whole for the service they have rendered, in the course of their duty, for the general well-being of our community.

R. M. Algie,
Minister in Charge of the
Department of Scientific and Industrial Research.

SECRETARY'S REPORT

The Hon. R. M. ALGIE, Minister in Charge of the Department of Scientific and Industrial Research.

I HAVE the honour to submit herewith the annual report of the department for the year ending 31 March 1954.

In 1926 the Government invited Sir Frank Heath, the Secretary of the Department of Scientific and Industrial Research in the United Kingdom, to report on the organization of scientific research in New Zealand. His report (H–27) recommended the setting up of a new department to take over the scientific units then controlled by a number of different departments, and the establishment of an advisory Council of Scientific and Industrial Research "to encourage scientific research and to organize its application to the primary and secondary industries". These recommendations were embodied in the Scientific and Industrial Research Act passed on 31 August 1926, and the Council held its first meeting in October 1926.

The functions of the Department are stated in section 5 of the Scientific and Industrial Research Act 1952 as follows:

5. (1) The department shall be charged with the maintenance and administration of such scientific services and laboratories as may be transferred to it, or as may be hereafter created or established and placed under its charge.

(2) It shall also be the duty of the department to advise the Government on all questions of policy relating to scientific matters that may be referred to it.

(3) The department shall also be charged with the following functions, namely—

(*a*) To maintain all principal standard measures for the time being in the custody of the Minister:

(*b*) To compare principal standard measures with corresponding standard measures outside New Zealand . . . :

(*c*) To compare with principal standard measures, and to certify, such copies thereof and such secondary standard measures or denominations derived therefrom as may from time to time be required.

Under clause 15 of the Act power is also given for the establishment and award of scholarships and fellowships for the purpose of enabling qualified persons to carry out independent research in any branch of science.

The functions of the department as defined in the Act make no mention of the primary reason given by Sir Frank Heath in his report to Government in 1926, viz., "to encourage scientific research and to organize its application to the primary and secondary industries". Sir Frank Heath's statement has, however, been the guiding principle in the development of the department over the past twenty-eight years. If the Act were being redrafted now, a statement of the department's present functions would be as follows:

The functions of the department shall be—

(*a*) To initiate, co-ordinate, and carry out scientific research related to the welfare of the people of New Zealand or its dependencies:

(*b*) To provide scientific services for other Government departments, or other bodies:

(*c*) To promote and establish "research associations" in connection with any of the industries of New Zealand, and to co-operate with and make grants to such associations when established:

(*d*) To collect and disseminate scientific information, including the publication of scientific reports and journals:

(*e*) To encourage the training of research workers by establishing and awarding research scholarships or fellowships:

(*f*) To make grants in aid of research to University staff, or other suitable persons or bodies.

The Act also established an Advisory Council consisting of a Chairman and not more than eight other members, not more than two of whom may be civil servants. The functions and duties of Council are stated in section 10 of the Act as—

10. (1) It shall be the duty of the Council—

(*a*) To consider and report to the Minister upon the scientific aspects of all proposals made to the department for the encouragement and organization of scientific and industrial research:

(*b*) To submit annually to the Minister a programme of the work, with estimates of the cost thereof, for each of the scientific institutions and services under the control of the department:

(*c*) To make recommendations as to the expenditure of money by the department in grants for purposes of scientific research:

(*d*) To advise the Government on the scientific aspects of any proposals made by any other department of State and referred to the Council for its consideration and recommendations.

Council meets five times a year and considers programmes of work in the various branches of the department and how available funds should be divided over the department's various activities. They are assisted in this by a number of specialist committees. They also consider all applications for research grants, for overseas travel, and for fellowships, and with the help of specialist committees advise on any proposals for extension or modification of the activities of the department.

The department wishes to place on record its deep appreciation of the assistance given in a wide number of fields by the various advisory research committees established by the Council.

Council's membership as at 31 March 1954 was—

Sir Theodore Rigg, K.B.E., M.A., M.Sc., F.R.I.C., F.R.S.N.Z. (Chairman).

J. C. Andrews, Ph.D., M.Sc. (Deputy Chairman).

G. A. Currie, B.Sc. (Agr), D.Sc., Hon.LL.D. (Aberdeen), Hon.Lit.D. (Western Australia).

E. J. Fawcett, M.A. (Cantab.).

E. R. McKillop, O.B.E., M.I.C.E.

R. O. Page, D.Sc.

H. D. Purves, M.Sc., M.B., Ch.B.

J. M. Ranstead, Bledisloe Medallist, and Dip., C.A.C.

D. F. Sandys Wunsch, M.A. (Oxon), B.Sc. (McGill), M.I.Chem.E., Assoc.Inst.M.M.

W. M. Hamilton, M.Agr.Sc., D.Sc., N.D.H. (N.Z.), (Secretary).

The Council of Scientific and Industrial Research held five meetings during the year, and maintained a constant review of projects and finances administered by the department. A departure was made during the year by holding a meeting of the Council in Hamilton in September 1953 in order to give members the opportunity of inspecting work at the Ruakura Animal Research Station and the Rukuhia Soil Fertility Station of the Department of Agriculture, and of visiting the Kinleith plant of New Zealand Forest Products and the geothermal work at Wairakei. A meeting was also held in Nelson in February 1954 when members inspected the work in progress at the Cawthron Institute, the Appleby Research Orchard, the Entomological Research Station, and the Tobacco and Hop Research Stations.

The department is greatly indebted to the Council for its continued interest and for its valuable criticism and guidance in many matters associated with the promotion of scientific research and the work of the department.

ACCOMMODATION

I am pleased to report that good progress has been made with the new building at Grasslands Division, Palmerston North, to replace that destroyed by fire in 1940. The new building of 6,500 square feet has been erected in permanent materials to harmonize with the existing chemistry wing erected in 1946, and should be occupied by June 1954.

The Botany Division have completed their transfer to new quarters in Christchurch. This rented accommodation provides much needed relief from the grossly overcrowded conditions under which the Division has operated in Wellington for many years. As part of a policy of grouping branches adjacent to one another wherever possible, it is desired that new quarters for the Botany Division should be erected at Lincoln adjacent to the existing Crop Research Division.

The Underwater Research Laboratory has also been shifted from limited and unsuitable space in Auckland to accommodation better suited to its needs which has been provided by the Navy at Narrow Neck.

It is essential that branches of the department, such as Botany Division, Geological Survey, and others holding collections of national importance, should be housed in fireproof accommodation. It is a constant source of concern that a branch, such as Geological Survey, with records and specimens representing nearly a century of effort, should be housed in an old wooden building, which constitutes a serious fire hazard.

An additional 10 acres of land adjoining the present area at Owairaka have been purchased for the Plant Diseases Division and the Fruit Research Station, and should suffice for the needs of these two branches for many years to come.

GENERAL

During the year discussions have taken place with the New Zealand Meat Producers Board and the freezing companies regarding the establishment of a meat research association along similar lines to the Dairy Research Institute. Discussions are still proceeding, but it is hoped finality will be reached in the coming year. With a return to free marketing in the United Kingdom no effort should be spared to ensure that our produce retains the high quality on which its reputation has been based.

Some regrouping of the department's activities on oceanography has also been commenced, and the study of marine biology and geology, together with studies of the temperature, salinity, and movement of water masses in the New Zealand area, will be increased in the coming year. Such information is basic to the fishing industry, important to navigation, and is a prerequisite to a proper understanding of harbour, estuarine, and tidal problems.

Dr A. G. Bogle, Director of the Dominion Physical Laboratory, left during the year to fill the Chair of Electrical Engineering at Auckland University College. The vacancy thus created has not yet been filled, and Mr I. D. Dick, Assistant Secretary, who is in charge of the Dominion Physical Laboratory, has been acting as Director.

During the year Council was asked to report on building research and established a small committee to examine the position. An officer of the department undertook a survey of the problems of the building industry for this committee, and Council should be in a position to report its findings to you later in the year.

In recent years the department has lost no fewer than eleven officers to professorial chairs in Universities. This is a distinct compliment to the officers concerned, but makes it difficult to maintain a staff of the highest calibre. Interchange of staff between the department and the University should be encouraged, but, because of differences in salary scales, the traffic at the moment is all one way. At the present time we are trading dangerously on the loyalty to the department of key scientific personnel. The future welfare of New Zealand depends in no small measure on the ability of those skilled in the fields of science and agriculture to promote further development, and it should be part of our national policy to retain in New Zealand a fair proportion of the best graduates of our Universities to work in these fields.

EXPENDITURE, 1953–54

Expenditure in the various branches of the department in 1953–54 is shown in the table opposite. The general wage increase that affected salary and wage scales over seven months of the year involved additional payments totalling approximately £28,000. The greater part of this was absorbed by savings in other items, resulting in expenditure exceeding estimates by only £9,808.

Table of Expenditure, 1953–54

Branch	Staff, 31 March 1954	Salaries	Other Expenditure	Total Expenditure, 1953–54	Voted, 1953–54
		£	£	£	£
Head Office	85	58,651	10,574	69,225	69,456
Animal Ecology Section ..	7	4,575	2,496	7,071	6,320
Applied Mathematics Laboratory	15	8,629	2,092	10,721	11,390
Auckland Industrial Development Laboratories	30	19,992	8,349	28,341	25,970
Botany Division	24	18,450	8,158	26,608	29,490
Crop Research Division ..	45	25,586	18,972	44,558	37,910
Dominion Laboratory ..	139	94,445	45,158	139,603	145,686
Dominion Physical Laboratory ..	184	126,254	63,546	189,800	193,470
Entomological Research Station	10	7,862	6,475	14,337	14,160
Fats Research Laboratory ..	17	10,306	4,300	14,606	14,640
Fruit Research Station ..	23	15,935	15,143	31,078	29,160
Geological Survey	55	40,012	12,009	52,021	55,545
Geophysics Division	59	42,287	31,535	73,822	73,732
Grasslands Division	81	48,508	27,031	75,539	70,235
Hop Research Station ..	3	2,312	5,554	7,866	6,890
Information Bureau	23	15,799	24,184	39,983	39,680
Plant Diseases Division ..	54	37,092	20,796	57,888	54,700
Scientific Liaison Service ..	3	6,938	5,642	12,580	12,770
Soil Bureau	67	45,259	22,542	67,801	61,475
Tobacco Research Station ..	4	3,219	3,496	6,715	7,460
Wheat Research Institute ..	9	6,789	2,581	9,370	9,000
Research, General	..	..	181	181	450
Scholarships	..	..	6,976	6,976	6,808
Miscellaneous	..	..	57	57	100
Grants—					
Universities and agricultural colleges	..	..	27,045	103,061	103,503
Incorp. Research Associations	..	..	37,144		
Statutory and miscellaneous ..	..	..	38,872		
	937	638,900	450,908	1,089,808	1,080,000
Less recoveries	..	..	..	64,394	61,000
Net expenditure ..	..	..	..	1,025,414	1,019,000

The actual staff employed on 1 April 1953 was 931, but provision was made in the estimates for 42 persons to fill vacancies existing at that date, giving a total of 973. By 31 March 1954 only 6 of the 42 vacancies had been filled, making the actual staff at that date 937, as shown above.

The staff at 31 March 1954 comprised professional, 374; clerical, 162; technical, 347; other, 54: total, 937.

In order to place the above table in perspective, figures for the last five years, and estimates for 1954–55, are shown in summary below, together with a column showing the expenditure of D.S.I.R. as a percentage of the national income (gross national product).

Year	Total Staff at 1 April	Gross Expenditure	Cost Per Staff Member	Gross National Product	D.S.I.R. Expenditure as Percentage of National Income
		£(000)	£	£(m.)	
1949–50	929	959	1,032	552·4	0·174
1950–51	981	962	981	696·2	0·138
1951–52	997	1,096	1,099	720·3	0·152
1952–53	1,013	1,010	997	753·4	0·134
1953–54	931	1,090	1,171	827·1	0·132
1954–55	936	1,144†	1,222	*	*

* Figures not yet available. † Estimates.

An analysis of last year's expenditure shows that effort was distributed approximately as follows:

	Percentage of Total Expenditure
Services to other Government departments and public bodies	24·7
Services to farming and industry, including research to meet their needs	53·0
Grants to University colleges, Research Associations, etc.	9·5
Administration, information services, and publications	12·8
	100·0

Analysed on the basis of the type of industry served, just over £500,000 (or 47 per cent of expenditure) was directed to research and service to farming industries, the remaining 53 per cent being spent on service and research to other industry and in the maintenance of permanent scientific services for the Dominion as a whole, e.g., time service, magnetic survey, etc.

RESEARCH

In the following section a brief review of work completed during the year is given. Items that appear to be of general interest have been selected, and are outlined in non-technical terms with sufficient background information, where necessary, to explain the significance of the work. No attempt has been made to cover all work completed or necessarily to mention every branch of the department.

AGRICULTURAL RESEARCH

Soil Surveys.—Since over 95 per cent of the exports of New Zealand comprise pastoral products, the fullest possible knowledge of the soils from which this production stems is of fundamental importance to our economy. During the year the Soil Bureau has published a bulletin giving a "General Survey of the Soils of North Island, New Zealand". This bulletin aims at a stocktaking of our soil resources on a scale not attempted in any other country. The scale of the maps (4 miles = 1 in.) is detailed enough for follow-up work by other investigators and yet bold enough in grouping to supply an over-all picture of the Island. The bulletin aims at influencing the trend of land use in a broad way rather than supplying the details of any single area. It should also prove invaluable as a basis for systematizing other knowledge about the land, and as a base for maps showing the distribution of minor element deficiencies, manurial responses, etc.

Preliminary maps of the South Island on the same scale are now being copied for issue to other departments for their use and criticism, preparatory to later publication in the same form as the North Island bulletin.

Minor Element Deficiencies.—The four-fold increase in output of the farming industries over the last fifty years has been due in no small measure to the pasture improvement consequent on topdressing with phosphates and lime. For many years no other fertilizers were

considered necessary for pasture growth, but in recent years potash has been assuming importance on many soil types. The first indication that minor elements might play some part in animal thrift came when bush-sickness was eventually diagnosed as cobalt deficiency in 1936.

As farming is intensified, and extended on to previously marginal areas, we are becoming increasingly aware of the part minor elements play in plant and animal health. Besides the major plant nutrients—nitrogen, phosphorus, potash and lime—we now know that some soils in New Zealand are deficient in one or more of the minor elements—cobalt, boron, magnesium, manganese, zinc, copper, sulphur, or molybdenum—and that maximum production cannot be attained unless these deficiencies are corrected.

The Soil Bureau has therefore commenced a survey of the minor element status of the major soil types in the Dominion. Chemical extraction of soils for analysis has limitations, since chemical methods do not always differentiate between compounds that are "available" to the plant and those that are not. A plant (sweet vernal) which grows throughout New Zealand was therefore selected, and samples growing on untopdressed soils were collected from 210 soil types throughout the country. In this way it is hoped to eliminate the uncertainty of the chemical methods by letting the plant indicate what soil nutrients are available to it. The samples of sweet vernal are each being analysed spectrographically for 25 elements. Work to date shows that the ash of sweet vernal varies widely with the composition of the soil upon which it is grown. For example, where grown on some limestone soils the plant contains 0·6 per cent of calcium, whereas on certain volcanic ash soils it contains 0·2 per cent. Molybdenum is high in many limestone soils and in most peats, but is very low in many North Auckland andesitic soils. Copper also varies significantly. The high molybdenum of the limestone soils is associated with high copper, whereas on many peats it is associated with low to moderate copper—a condition dangerous to stock health.

The importance of minor elements in achieving and maintaining a high level of farm production is likely to increase as time goes on. The present study therefore aims at delimitation of the areas where minor elements are likely to be of importance now—or in the future—as a guide to extension workers and farmers.

Bloat.—No disorder of cows causes the dairy farmer more anxiety, and in certain seasons few cause higher mortality, than bloat. The interest of the Grasslands Division arises from the opinion, frequently expressed by farmers and veterinarians alike, that the severity of the disease increases with increasing use of the improved strains of grasses and clovers originating from the Grasslands Division. During the past five years considerable success in controlling the disorder through changes in management methods has been achieved both on the Massey College dairy farm and on selected farms throughout the Manawatu, but it is apparent that the methods are applicable only on those farms where a high standard of management is already practised. The two prerequisites for a general method of control are a knowledge of the materials within the leaves of our grasses and clovers that cause the disorder and of the reasons for the marked differences in susceptibility among cows grazing the same pasture.

An intensive investigation to these ends was started in 1952, and, following two seasons' work on stall-fed animals, considerable clarification of the multitude of theories about the disorder is possible: (1) red clover is entirely satisfactory for experimentally producing bloat in stall-fed, dry dairy cows; (2) bloat occurs on red clover only at certain times of the year, but stage of growth appears to be of much less importance than rapidity of growth; (3) rain and dew have little or no effect in increasing bloat activity of clover; (4) bloat was produced on cut clover at all stages of wilting up to the hay containing 72 per cent dry matter; (5) pre-feeding with hay or concentrates did not prevent bloat when red clover was subsequently fed *ad lib.;* (6) where feeding time for the same amount of herbage was doubled there appeared to be no reduction in bloat severity; (7) press juice from frozen clover produced bloat; (8) injections of adrenalin gave no relief to bloated animals; (9) bloat has been prevented before eating and relieved after eating by drenching with anti-foaming agents; and (10) belching can be readily observed in bloating animals up to the stage of acute distress. Thus far there is no evidence of any inhibition of the belching mechanism.

The results obtained to date indicate that bloat is caused by some water-soluble material or materials with foam-producing properties, and that a study of the physical condition of the rumen contents is the most promising line of investigation.

Cocksfoot.—In the lower rainfall areas and on the lighter soils of New Zealand cocksfoot is one of our most valuable pasture species. It is a perennial, is highly productive, is relatively drought resistant, and is a good summer producer. For many years the Akaroa strain harvested from Banks Peninsula has been highly regarded both in New Zealand and overseas, and on the inauguration of the seed-certification scheme this strain was used as the basic seed supply. Subsequently, certified seed of a bred strain, C23, produced at Lincoln College became available.

Trials at the Grasslands Division with these strains and others from abroad indicated that a more productive strain was desirable, particularly for North Island conditions. A strain based on plants of New Zealand origin has now been produced, and after trials at the Grasslands Division, Palmerston North, and at the Division's Lincoln and Gore substations, has been released under certification. Mean production figures for a three-year period have shown that at the three locations the annual production of the new strain is 13 to 20 per cent higher than that of C23. The new cocksfoot has a wider seasonal range of production, and begins growth earlier in the spring, its spring production in the three locations being 18 to 23 per cent higher than that of C23.

Although leaf production is of prime importance in a pasture plant, seed production cannot be ignored. In seed-production trials carried out over a four-year period at Palmerston North, Lincoln, and Gore, no significant difference has been obtained between C23, Akaroa, and the new strain. Seed of this cocksfoot is now being grown under certification and certified pedigree seed has been harvested this season.

Lucerne and Clover Inoculum.—It is a well known fact that many leguminous plants, such as lucerne, will not establish satisfactorily unless they are supplied with a suitable kind of bacterium that produces the characteristic nodules on the roots. It is for this reason that the

department has for many years maintained a service to farmers by supplying cultures of a suitable organism for treating lucerne seed prior to sowing. Increasing use has been made of this service year by year, and in the past season enough culture was prepared and distributed by the Plant Diseases Division to treat nearly 390,000 lb. of lucerne seed.

More recently collaborative work has been undertaken within the department to see to what extent deliberate inoculation of various kinds of clover seed would assist establishment. Trials carried out by the Plant Diseases Division in widely separated areas throughout the Dominion have shown that the establishment of red, white, and subterranean clovers can be markedly improved by inoculation of the seed with selected efficient strains of nodule bacteria. Strains are by no means equally efficient, and inoculation with poor strains gives negligible benefit to establishment even though plenty of nodules may be formed on the roots. A few strains of those that have been selected are efficient on all three clovers, and this should greatly simplify the problem of producing culture in quantity for field use. From the results of limited trials that have so far been laid down it appears that some strains may be equally efficient in widely differing environments in different parts of New Zealand. If confirmed, this will also simplify the problem of large-scale production and use. The effect of inoculation can be quite spectacular in the development of the plant; for instance, clovers inoculated in trials in Otago with efficient strains at sowing produced at the end of four months approximately twenty times as much top growth as uninoculated clovers. Promising results have been obtained in small plot trials on North Island pumice land, where establishment of clovers in the first six months after sowing is often difficult. Experiments are in hand to try to find an economic yet effective method of applying the inoculum to commercial quantities of seed; there are difficulties in this, and they will have to be overcome before inoculation can be expected to be accepted commercially.

Grass-grub and Subterranean Caterpillar (Oxycanus).—The methods of control for these pasture pests worked out by the Entomological Research Station are finding increasing application year by year. In 1950–51, 153 tons of commercial insecticide-fertilizer mixtures were used; in 1951–52 the tonnage increased to 2,109, and in 1952–53 to 4,467 tons. In the 1953–54 season it is estimated that 6,200 tons of DDT-superphosphate were manufactured. In terms of DDT this field use of p.p.i. (para-para isomer) DDT has risen from nil in 1949–50 to approximately 107 tons in 1953–54. The importance of the use of DDT for grass-grub and *Oxycanus* control can be appreciated when it is realized that of a total of approximately 150 tons used in the Dominion this year it has been estimated that 107 tons will be used to control these pasture pests alone. Of the remaining tonnage, about 20 is used for orchard work, and 20 for fly sprays and other purposes. It has been estimated that in the Canterbury and Waikato farming areas alone there is an area of 3,500,000 acres of pasture liable to grass-grub attack, with an annual production loss in the vicinity of £4 million. These figures give some idea of the scope for improving production throughout the Dominion by using these control methods.

An extensive series of plots, including DDT, BHC, lindane, aldrin, and dieldrin, were laid down during the year to compare materials of different particle sizes and origin, and also to compare wettable powder with dusts as controlling agents for grass-grub.

One of the troubles confronting farmers wishing to use DDT-fertilizer mixtures is the uneven quality of some mixes. Dominion Laboratory analyses of some of these mixes showed that distribution of insecticide within a batch was often very poor, although the correct amount of DDT had been included in each batch. One batch of DDT-fertilizer samples analysed showed that individual bags ranged from one twelfth to ten times the requirement of DDT, resulting in very patchy control on farms. This problem of mixing is serious because it gives inefficient control and could lead to loss of confidence by the farmer in the Station's recommendations. Another source of trouble has been that some firms handling DDT have not understood that it is the p.p. and gamma isomer content of DDT and BHC respectively that is significant from the insecticide point of view. One lot of DDT sold for experimental work as 100 per cent p.p.i. was found on analysis to be slightly over 4·5 per cent p.p.i.

A careful watch is being kept on the possibility of DDT accumulations occurring in animal fat of export meat. Dominion Laboratory analyses have shown that lambs and ewes fed only on DDT-treated pasture prior to slaughter contained insignificant quantities of DDT.

Manuka Blight.—The investigation by the Entomological Research Station into the roles of *Eriococcus* and the associated fungus in relation to death of manuka (*Leptospermum scoparium*) has been continued. Over 100 specimens of manuka and other plants from all over New Zealand have been examined and the coccids identified. Mapping of *Eriococcus* distribution has been continued. The *Eriococcus* responsible for the killing of manuka has been described as a new species, the origin of which is still not known. An interesting fact that has come to notice this year is that *E. leptospermi,* which was described over sixty years ago on *Leptospermum* in Australia, has now been found on *L. scoparium* in New Zealand, and there is some evidence to suspect that it also causes death of this plant in certain northern portions of the South Island. This point requires further work and survey before a definite pronouncement is made, however, and such investigations will be carried out later this year.

Wheat Breeding.—With one exception, the wheat varieties grown in New Zealand have been produced by plant breeders in this country. The exception is Dreadnought, an old English wheat that is mainly grown on some 5,000 acres in South Canterbury and North Otago. On this heavy land Dreadnought far out-yields the standard variety Cross 7, and is preferred by farmers despite the fact that much grain is lost by shattering, that the variety lodges badly, and that much time and labour is lost as Dreadnought is not direct-headed.

It is proposed to release for commercial trials in this area a line produced by the Crop Research Division which shows promise as a Dreadnought replacement. This line has given high yields in previous trials, ripens two weeks earlier than Dreadnought, has not been observed to shatter or lodge, and is suitable for direct heading; the baking quality of the grain is equivalent to that of good Dreadnought.

Milford Oat.—The varieties of milling oats grown in New Zealand have one grave disadvantage: they are weak-strawed and lodge badly. This problem now appears to be solved, following tests of S 225—a line received from the Aberystwyth Plant Breeding Station in 1949. This

variety has short, stiff straw and is suitable for header harvesting. In trials here S 225 has given yields equivalent to those of Onward and Abundance, and in one milling test was only slightly inferior to Onward. The variety will be released here under its English name, Milford.

Linseed.—Golden Viking, the most popular linseed variety in New Zealand, has several disadvantages. It is not resistant to rust disease, and in 1952–53 was seriously attacked by another fungus (Pasmo), which resulted in a serious reduction in yield. Tests of introduced varieties have shown that when Pasmo was severe the variety Marine, because of its resistance to the disease, yielded well above Golden Viking. Marine has firm straw, and matures earlier than Golden Viking, which would facilitate autumn sowing of wheat after linseed. It is only susceptible to the rare and weak Race 12 of rust. Although Marine may not yield as heavily as Golden Viking in a disease-free year, it is a more reliable variety for New Zealand, and will be in commercial trials next season.

Determination of Crop Varieties.—In endeavours to provide a supply of first-grade fruit trees that are true to name, there has been some difficulty in determining the standards to be adopted for New Zealand varieties. It has been found that locality exerts a marked influence on fruit, especially on peaches and apples. Variations are sufficient to make many existing overseas descriptions valueless. "Delicious" apples, for example, grown in Central Otago have a tall, conical form with a tightly closed calyx, whereas in Auckland the variety is typically broad and squat, with an open calyx that allows ready entry of the fungus spores producing "mouldy core". By interchange of budwood between the two districts it has been shown that these fruit differences are not characteristic of individual trees, but are induced solely by environment.

From the time of the first settlement, successful introductions of hops have been made from England, and thirty New Zealand named varieties are now known locally. Close study of their botanical characteristics has shown, however, that out of these there are only eight distinct varieties, of which only five are commercially grown.

Until recently 90 per cent of commercial tobacco grown in New Zealand has been of one variety, and this has remained genetically uniform for many years. During the search for root-rot resistant strains, a new introduction was recently made from the United States of America. Though nominally of the same variety, this new introduction differs widely from the established plants, and could well be regarded as a new variety.

Early development of vegetable varieties was carried out mainly by seed firms and gardening enthusiasts. There is great variation of type within strains and varieties of commercial vegetable seeds, especially among the Brassicas. Steps are being taken to reduce this by bulk seeding of selected plants, followed by progeny testing and further selection. Nucleus seed is then handed over to the Horticultural Division, Department of Agriculture, for seed increase and distribution. Lines of savoy cabbage have now been developed that show great improvement in percentage of marketable heads, uniformity of type, and uniformity of maturity.

Such characterization and definition will greatly simplify the provision of varieties most suited to the soils and climate of New Zealand, and will also simplify the problems confronting commercial producers.

Fruit-tree Virus Diseases.—In this country in the past it had been generally thought that orchard trees were not subject to virus diseases, but in recent years investigations by the Plant Diseases Division and the Fruit Research Station established that several puzzling phenomena are in fact the symptoms of viruses. There is evidence that several of the viruses restrict both growth and yield of infected trees throughout their life, but no curative treatment is available. The problem has therefore had to be tackled by concentrating on finding healthy trees from which budwood could be taken, and on removing infected stocks from nurseries. Many infected trees formerly used to supply budwood have been discarded, and infection amongst stocks has been markedly reduced. Practical control of plum mosaic among cuttings grown as stocks has been achieved simply by removing infected plants. Six years ago over 30 per cent of cherry plum cuttings in a large nursery were infected, but this season there was only one plant in nine thousand showing infection. This success gives a double saving: first, the nursery is saved the failure that follows attempts to bud some varieties on to infected stocks; and, second, future crop losses that would follow the planting of infected trees are avoided. Moorpark mottle of apricots, and ring spot of apples (formerly known as Henderson spot), previously of unknown cause, can now be attributed to undescribed viruses.

A comprehensive bulletin (No. 108) prepared by an officer of Plant Diseases Division and covering our present knowledge of "Plant Virus Diseases in New Zealand" has been published during the year and illustrates the symptoms of the fruit tree viruses mentioned above.

Tobacco.—The removal of lateral growths that develop in the axils of the leaves after the tobacco plant has been topped is an operation that makes heavy demands on labour at a period when growers are fully occupied with the harvesting of the leaf. Spraying the upper leaves once immediately after topping with a 1 per cent or ½ per cent solution of maleic hydrazide resulted in complete suppression of laterals. The application of mineral oil, either alone or as an emulsion, brought about some reduction in lateral growth. Reports on leaf quality are not yet available.

The new variety, Virginia Gold, had proved its resistance to black root-rot by producing good crops on areas so badly infected with disease that they were not worth planting to other varieties. A brittleness of leaf associated with Virginia Gold has been corrected by the use of 5 lb. of borax per acre in the fertilizer. Breeding for greater resistance to black root-rot is continuing, and some highly resistant, high-yielding lines have been developed. Their release to growers will depend on their smoking quality.

Rabbit Population Studies.—During the past year considerable progress has been made by the Animal Ecology Section with the analysis of data on reproduction and parasites of rabbits collected in previous years. At the same time it was necessary to collect rabbits from other localities in both Islands so that the final conclusions would have wider application in time and area.

The Section also investigated the extent to which populations of rabbits from different environments within the one general area may vary with respect to their reproductive success and parasitic burden. Substantial samples of rabbits were collected from two areas about a

mile and a half apart in the Duntroon district (North Otago). One locality was an overgrazed, dry river bed, while the other was a paddock of fairly long grass carrying fewer rabbits than the river bed. On the short pasture the rabbits were all adults or small young, but the other population contained many large young, some of which themselves were already breeding. There were also significant differences in the size of the parasite populations, *Coccidia* being more severe in the long grass but parasitic worms being more numerous on the short area. It is particularly important to understand the factors causing successful early breeding, because this phenomenon results in an increase in the number of breeding animals later in the season, thus giving a "snowball" effect to the population build-up.

HEAVY WATER AND GEOTHERMAL INVESTIGATIONS

Interest in the use of nuclear reactors (atomic piles) as sources of power for peaceful purposes has been developing rapidly overseas. Estimates place present world coal reserves at between 2 and 6 million million tons, or a minimum of 1,000 tons per head of the world's population. Annual consumption is about two-thirds of a ton per head, so that even allowing for increasing consumption world coal reserves are adequate for a long period. Coal reserves are, however, by no means evenly distributed and many countries either lack supplies or have only small reserves.

Estimates of known reserves of uranium amount to 25 million tons. Used in the type of nuclear reactor now currently in use, a ton of uranium supplies energy equivalent to approximately 10,000 tons of coal. When more efficient methods of utilizing uranium by means of self-sustaining or breeder reactors have been perfected, 1 ton of uranium should replace approximately 3 million tons of coal. On the basis of using breeder reactors the world reserves of energy in the form of uranium are at least twelve times as great as the higher estimates of coal reserves and thirty-seven times those of the lower estimates.

The types of nuclear reactors currently being built overseas as experimental power sources use either purified graphite (a form of carbon) or heavy water as a moderator. Heavy water is much more efficient than graphite and a pile using it can be made smaller and more compact than one using graphite. The minimum size of nuclear reactor that will operate using heavy water needs 3 tons of uranium in 5 tons of heavy water, as compared with 25 tons of uranium and 650 tons of graphite when graphite is used as a moderator.

Heavy water occurs naturally in small amounts in all water (1 part in 5,400 by weight). A gallon of heavy water weighs 11 lb., as compared with 10 lb. for ordinary water (hence its name), and has a boiling point of 101·42° c., compared with 100° c. for ordinary water. It is made commercially in Norway and elsewhere by electrolytic separation, which requires the use of large quantities of electricity. The commercial price for small quantities is approximately £70 per pound. Because of its slightly higher boiling point it can be separated from ordinary water by fractional distillation in much the same way as crude petroleum is distilled in a refinery. Large quantities of heat are required for distillation, and heavy water separated in this manner would therefore normally be very expensive owing to the quantities of

coal required. The world output of heavy water is not large, and because of the growing demand an investigation into the possibilities of using heat from geothermal steam for its production in New Zealand was undertaken, in conjunction with United Kingdom authorities.

Whether or not heavy water production is undertaken in New Zealand in the future, most of the investigatory work was in any case required for the development of power from geothermal steam and has served to place that project on a firmer basis. The activities of the department have been directed along a number of lines. Success in boring for steam depends in considerable measure on a correct interpretation of the underlying geological structure, and considerable effort has been directed to geophysical and geological surveys covering the Rotorua-Taupo thermal areas. A gravity survey, which provides information on the depth of volcanic debris overlaying the basement greywacke, will be completed by the Geophysics Division by the end of the present field season. More detailed surveys of the Waiotapu area are also in progress, in which seismic and gravity methods are used to assist in elucidating the geological structure of the area, and magnetic and electrical methods to define the extent of high temperature conditions near the surface. Drilling has been used to determine the quantity and quality of steam obtained at shallow depths.

The Dominion Physical Laboratory has continued and extended observations of the temperature and discharge of selected hot springs, the periods of geysers, etc. The period of systematic measurements in the Wairakei Valley now extends well over a year and similar measurements at Waiotapu have been carried on for some months. Natural thermal features suitable for similar measurements have been selected at Orakeikorako, where work will begin shortly, and this observational work will be gradually extended over more of the thermal area as time and staff permit. These observations are intended to give a reliable measure of the natural heat output of the various thermal areas and also to assess whether the bores now blowing at Wairakei are in any way affecting the natural phenomena in the Wairakei Valley.

The Geological Survey is continuing its surveys of the geology of the thermal areas and maintains close contact with the Ministry of Works on the siting of bores and the examination of drill cores and drillings to help in interpretation of the underground structure. The results of drilling at Wairakei tend to confirm the opinion that the steam and hot water come from a structure believed to have a north-south trend.

The Dominion Laboratory has erected equipment alongside No. 9 bore at Wairakei to test the resistance to corrosion of various metals and alloys when subjected to cleaned, dry steam from a typical bore. This will provide necessary information on corrosion for heavy water plant design. In addition, a series of corrosion tests on metals used in the construction of steam turbines is under way. Tests are also being made of methods of separating water from the steam and the effect of impurities in the steam on its corrosive properties.

Expenditure by the department on geothermal investigations in 1953–54 was approximately £20,300, making a total expenditure in the last four years of £84,000. A popular account of the whole project is in the course of preparation and should be printed later this year.

RADIOCARBON DATING

The radiocarbon method of determining the age of carbonaceous materials was developed by workers at the University of Chicago. The basis of the method lies in the fact that a small quantity of radiocarbon (C^{14}) is continually being produced in the upper atmosphere by transmutation of nitrogen (which comprises 80 per cent of the atmosphere) by cosmic rays, which are continually entering the earth's atmosphere from outer space. The atoms of radiocarbon produced in this way combine with oxygen to form radioactive carbon dioxide, which becomes distributed throughout the atmosphere by air currents. The radioactivity of the carbon dioxide in the atmosphere has, over a long period, become constant because the production of radioactive carbon atoms is balanced by their decay.

Radioactive carbon dioxide is absorbed by plants and built into their tissues in the same way as ordinary carbon dioxide, so that in living plants the ratio of radioactive to ordinary carbon is the same as that existing in the atmosphere. On the death of the plant the radioactive carbon proceeds to decay into ordinary carbon and after 5,568 years half the radioactive carbon will have decayed to ordinary carbon. Thus the measurement of the ratio of radioactive to ordinary carbon in a sample of wood or other carbonaceous material of unknown age allows the time since it was living to be determined. Thus, if the ratio were found to be only half that found in a living plant, we would know that the material was 5,568 years old; if one-quarter, then 11,136 years old, etc.

The measurement of this ratio of radioactive to ordinary carbon in samples of unknown age is in practice a very difficult problem owing to the small amount of radiocarbon present. Very sensitive counting apparatus must be used, and the counter must be surrounded by heavy lead or iron shields to exclude extraneous radioactivity, while the sample itself must be purified by most exacting techniques to remove all traces of other radioactive contaminants. Not more radioactive impurity than the equivalent of 1 part of radium in 100,000,000,000,000,000 parts of carbon can be tolerated in the purified sample; the equivalent of a pint mixed uniformly through the waters of Lake Taupo.

It is pleasing to record that two officers of the Dominion Laboratory and Dominion Physical Laboratory have developed the technique for use in New Zealand, thus becoming the first laboratory in the Southern Hemisphere to use the method and among the first four in the world.

In the form originally developed the method can be used for determining the age of material up to 20,000 years old. These officers have now made substantial improvements in the method, and when the apparatus has been rebuilt it is expected that the range will be extended to 45,000 or 50,000 years, with a substantial saving in the time required for chemical preparation of the samples.

Radiocarbon (C^{14}) dating in effect gives us an absolute chronology of the events of the last 45,000 to 50,000 years, and promises to be an invaluable aid to the geologist, the soil scientist, the botanist, and the archaeologist. Wood, charcoal, peat, bones, shells, or other organic remains can be dated, and frequently can be used to date the deposits in which they lie, e.g., buried logs in river terraces, or plant remains under volcanic ash showers.

Already the method has yielded results of considerable interest in dating a number of the ash showers that blanket a large part of the centre of the North Island. The "Taupo shower", which covers an area of approximately 8,800 square miles, occurred about 1,700 years ago, and the "Kaharoa shower", which covers the area from Tauranga to Whakatane and inland nearly to Rotorua and Te Whaiti, fell about 700 years ago. Several older ash showers, originating in the Taupo area, have also been dated, and gradually a fuller knowledge is being developed of the history of volcanic activity on the central volcanic plateau. It is already clear that during the past 9,000 years, and probably much longer, there have been, at more or less regular intervals, eruptions of rhyolite from a number of vents in the Taupo-Rotorua area. The later eruptions included glowing avalanches. This indicates that the greatest potential danger is from such rhyolitic eruptions, and not from the active andesitic volcanoes of the Tongariro National Park.

MEAT DEHYDRATION

During the war period New Zealand, at the request of the United Kingdom, established plants for the dehydration of meat. The dried mincemeat produced was used as part of the ration in combat areas where refrigeration facilities were not available. The process involved drying of pre-cooked meat on trays placed in a drying tunnel. The product was not easy to reconstitute, tended to have a gritty texture, and was no substitute for a steak or chop.

Because of our wartime experience, and as one of the major meat exporting countries in the Empire, New Zealand was asked to continue research and, if possible, to develop an improved method of dehydrating meat. A small team in the Dominion Laboratory has been working on the project and has developed a process that permits the drying of meat in slices up to half an inch thick. The method involves submerging slices of frozen meat in melted fat at 140–160° F. and extracting the moisture under vacuum. A pilot plant able to deal with 50 lb. of raw meat at a time has been constructed and operated satisfactorily to produce material for consumer trials. Both beef and mutton have been dehydrated satisfactorily, and acceptability trials have been carried out by Army and mountaineering personnel. Dried meat produced by this process was taken by Sir Edmund Hillary on his recent Himalayan expedition to test its keeping quality and acceptability under adverse conditions.

Tests to date have been very encouraging and a request has been received for 5 tons of the dried produce for large-scale consumer trials in the United Kingdom. While the product was developed primarily to meet possible wartime needs, it may also have limited peacetime application.

The fact that the product can be stored without refrigeration means that it can be transported in un-refrigerated cargo ships, while the fact that it is dried reduces the weight and bulk of material to be transported.

WHEAT RESEARCH

The Wheat Research Institute has now been operating for twenty-five years, and, at the request of the contributing industries, an amendment was made to the legislation providing for higher levies to meet

increased costs and to provide extra staff needed to restore the balance between research and service activities. The growth of service work is typified by the increase in the number of test loaves made. For many years, up to 1951, about 5,800 baking tests were made each year, but 9,500 were made in 1953, an increase of nearly 64 per cent. Many others were made for investigational purposes.

The Wheat Research Institute has, during the year, made improvements in the flour testing and reporting procedures to save avoidable work, and has continued a series of experimental studies of baking processes to check or to extend information used in technical publications issued to all bakeries. The flour classification system, under which every fortnight all bread bakers are given technical data on every brand of flour, proved highly successful in its first year of operation, and will be continued. The system helps bakers to make allowance for variations in flour characteristics and is thus specially helpful in mechanized bakeries where strict timetables are essential.

GEOLOGICAL SURVEY

Regional mapping, which is the basis for elucidation of the country's geological history and the ultimate development of its mineral resources, has proceeded in North Auckland, the lower Waikato, Hawke's Bay, West Coast, Nelson, Canterbury, and Southland. Special investigations have been undertaken at the request of the Island Territories Department and for the Fiji Government.

In co-operation with the Mines Department, the Survey proved large reserves of coal in the Maramarua area for possible steam-electric generation. Reserves of coal in the Kawhia district were investigated, and though this field will never assume major importance it contains a useful contribution to the industry. With the Mines Department, sulphides in the Kauaeranga Valley, Thames, are being investigated as a possible source of sulphur; the deposit is extensive, but sampling to date suggests the sulphur content averages about 7 per cent, a grade of raw material that is of doubtful commercial value under present conditions.

At the request of the Fiji Government, a geologist was released to assist in an investigation of the Suva earthquake of 14 September 1953. Movement along a major fault was traceable by a fresh scarplet on the island, but the largest topographic changes resulted from submarine landslides beyond the reef; at one place the present depth of water appears to be at least 300 ft. greater than before the earthquake.

SEA AND AIR NAVIGATION CHARTS

The department is now responsible for the annual preparation of charts showing the magnetic variation of the compass for an extensive area of the South-west Pacific Ocean. These charts are used in the revision of sea and air magnetic charts.

In the past the necessary magnetic data were obtained by the systematic ocean surveys conducted by the Carnegie Institution of Washington. These data, supplemented by continuous recordings at magnetic observatories located in Hawaii, Western Samoa, New Zealand, and Australia, were sufficient to keep the variation charts up-to-date. However, since the loss of the non-magnetic ship *Carnegie* at Apia in

1929 no systematic ocean magnetic observations have been made, and the accuracy of the variation charts of this area has therefore deteriorated. The Admiralty has pointed out that the charts at present in use may be in error by several degrees.

The shipping companies and the Royal New Zealand Navy are co-operating in a programme to determine the chart error at about thirty selected points. The Magnetic Survey is establishing "international repeat stations" on a selection of islands so that the chart, once corrected, can be kept up-to-date merely by measuring the variation at these stations every few years.

OCEANOGRAPHY

The study of water movements in the South-west Pacific in which both sea temperature and drift card data are used has been continued with the active support of the Navy and the shipping companies. This investigation is nearing completion, and will provide the background which is essential to a proper understanding of coastal problems.

Considerable progress has also been made on the general circulation of New Zealand coastal waters, and the submarine geology of the continental shelf, by utilizing temperature, salinity, and echo-sounder records supplied by the Navy and shipping companies. The continued co-operation of the survey vessel, H.M.N.Z.S. *Lachlan,* has been particularly important in this respect, and has provided biological research workers in the University colleges with a wealth of material.

POZZOLANAS

Pozzolanas are siliceous materials, such as volcanic ash, pumice, diatomaceous earth, burnt clays, shales, etc., which form a cement when mixed with lime in the presence of water. The name is derived from Pozzuoli in Italy, where a volcanic ash having such properties was first discovered and used in Roman times.

The use of pozzolanas to replace some of the portland cement in concrete has come into prominence in recent years, especially in large engineering works, such as dams.

Some of the advantages in the use of these materials in concrete are: improved workability; less generation of heat during setting, thus lessening the risk of cracking in massive structures; lower permeability; greater resistance to attack by aggressive waters or soils; reduced expansion from chemical reaction between alkalis in cement and reactive constituents in the aggregate; and possible lowering of cost by savings in the quantity of cement required.

Pozzolanic materials vary widely in their properties and effectiveness, and a considerable amount of investigation is necessary before any can be confidently recommended for such structures as hydro-electric dams. Many potentially useful naturally occurring materials have now been examined by the Dominion Laboratory and the Geological Survey, and some of the more promising of these have been the subject of larger-scale tests at the Dominion Physical Laboratory. During the year work has continued at the Dominion Laboratory, with particular reference to the fineness of grinding necessary and the resistance to

sulphate attack of concrete made with local materials. Two pozzolanas—diatomite from Whirinaki and pumicite from Kaimai—have been recommended for larger-scale concrete tests. There is no doubt that useful pozzolanas are available in this country and their extended use warrants serious consideration.

PHYSICAL STANDARDS

The Dominion Physical Laboratory has continued to make progress in the establishment of various standards in its care, and has received important items of equipment which have been on order for some years. Notable amongst these are a Diesselhorst thermo-electric-free potentiometer for temperature measurement, and the first of a range of precision balances for calibration of weights. Some 80 per cent of the original recommended range of standards equipment has now come to hand, but there is still much work to do in setting it up and developing techniques to the appropriate level.

Users of physical instruments throughout New Zealand have made good use of the reference instruments set up, particularly for calibrating good quality sub-standards, and care has been taken to foster, whenever possible, any outside agencies that might accept some of the established lower level routine of calibrations. Routine calibrations and test have continued at about the same level as previously. A total of about 120 instruments and 80 special gauges have been the subjects of calibration reports.

ELECTRON MICROSCOPE

The ordinary optical microscope is limited to a magnification of 1,500 to 2,000 times. The development of the electron microscope in recent years has permitted much greater magnifications to be obtained (50,000 to 150,000). This has enabled rapid advances in our knowledge of metallurgy, paint pigments, pottery clays, etc., and many phases of biology, e.g., viruses, that were invisible under the ordinary microscope.

The electron microscope at the Dominion Physical Laboratory has been in almost constant use, for Universities, Research Associations, industry, and for other branches of the department. On tobacco mosaic virus estimation, certain hypotheses have been formed concerning the relationship between infectivity and virus particle concentration in diseased saps, and experiments designed to test them are about to start. On morphology of bull spermatozoa, thin sections of spermatozoa cut with the microtome designed at the Laboratory have shown details of the head structure not visible by other methods. A study of the structure of dentine has been started in which replicas of ground and polished teeth are compared with thin sections of decalcified teeth cut with the microtome. It is hoped by this means to avoid confusion, which has arisen in similar studies in the past through changes due to fixation and decalcification. This work is being done for the Otago Dental School.

Photographs taken through the electron microscope showing details of fungal spores and their development are being used by the Plant Diseases Division in developing a suitable classification system for a group of fungi, the streptomycetes, which are difficult to classify by normal techniques.

FERTILIZER RESEARCH

In 1949 a world shortage of sulpher developed, and there were considerable doubts as to the future supply position since there are no large natural resources of sulphur or pyrites in New Zealand. A shortage of elemental sulphur would have a profound effect on our agricultural output, for New Zealand production of phosphatic fertilizers is at present based almost entirely on superphosphate.

In 1951 the New Zealand Government invited Dr G. L. Bridger, Iowa State College, United States of America, to visit New Zealand and report on the action that could be taken to relieve the effects of the sulphur shortage. Apart from recommending development of the use of pyrites, which would need to be imported, Dr Bridger recommended two alternative methods:

(1) The production of triple superphosphate.
(2) The production of fused calcium magnesium phosphate—by the fusion of olivine or serpentine and phosphate rock.

The manufacture of triple superphosphate is already a well-established process overseas, but the fusion process has only recently been developed and doubts exist as to its commercial possibilities and the suitability of the product for pasture topdressing under New Zealand conditions. The fusion process, however, had the following potential advantages:

(1) Smaller economic plant possible than for triple superphosphate.
(2) Lower capital cost for same output of P_2O_5.
(3) The fertilizer could be transported in bulk and stored in the open.
(4) The product is in a granular form suitable for aerial distribution.

The Chemical Engineering Section, Dominion Laboratory, therefore undertook a programme of development work—

(1) To prove the suitability of New Zealand olivine rocks.
(2) To determine the commercial possibilities of the method.
(3) To provide sufficient material for the purpose of field trials.

Small laboratory trials were made to find the best proportions of phosphate rock and olivine, or serpentine, to ensure maximum availability of phosphate in the finished product. Following these trials the Railways Department co-operated by agreeing to our using an electric furnace at the Hutt Workshops for production of 10 tons of fused calcium-magnesium phosphate. The final product contained 21–22 per cent P_2O_5, of which 90–95 per cent was soluble in 2 per cent citric acid.

This material is being subjected to full-scale field trials by the Extension Division of the Department of Agriculture. The work to date has shown that the process is technically feasible. It remains for a more careful assessment of the probable costs of commercial production to be made, and to await the results of the field trials. The trials are on both the unground material as it comes from the furnace and the finely ground product. Large deposits of suitable olivine and serpentine occur in the Nelson and Southland areas.

MANUFACTURERS' RESEARCH COMMITTEE

This Committee continues to advise and assist in matters concerning the promotion and application of scientific research in New Zealand's manufacturing industries.

The successful development of the industrial research associations and research groups is viewed with satisfaction by the Committee, and it is hoped that co-operative efforts in this form will be made by other industries.

The principle of financing these organizations by equal contributions from industry and Government has been examined with the object of revising the basis so that, after reaching such amounts as are commensurate with the national importance of each industry, future expansion will be provided by additional funds from industry with a lower rate of Government grant. During the past year the technical conferences have been introduced to more industries. These provide a valuable line of communication between the scientists and key workers in factories, and the enthusiasm with which they are attended indicates a healthy appreciation of this form of technical education.

Means of assisting the printing industry in conjunction with overseas research organizations were investigated, and one possible scheme has been placed before the industry. Negotiations for a group membership by New Zealand firms in the Production Engineering Research Association of Great Britain have been opened. A report on the foundry industry, which indicates the need for applying scientific technique to a much greater extent, was prepared by the Dominion Physical Laboratory at the request of the Committee. This report has been conveyed to the New Zealand Manufacturers' Federation, and it is hoped that some fruitful action will follow.

INFORMATION BUREAU

Publications.—The maintenance of up-to-date publication of both sections (Agricultural Research and General Research) of the *New Zealand Journal of Science and Technology* has provided for the speedy release of scientific information. The *Journal* is, in general, for the publication of articles dealing with original, significant research work. The standard required for acceptance of papers has been kept up, and the number of papers published in each section is approximately the same as in the previous year.

The staff of the Information Bureau have, during the year, edited and arranged for the publication of some 20 major bulletins, memoirs, etc., on behalf of the various branches of the department. In addition, apart from the *New Zealand Journal of Science and Technology,* there has been a number of publications edited by the Information Bureau and issued by the department; these included the annual report, bulletins of the Cape Expedition Series, and the *Departmental Handbook.* A *Scientific Information Newsletter,* designed to keep officers of the department both in New Zealand and overseas up to date on the current work of the individual branches of the department, has been issued monthly.

Technical Information Section.—This Section dealt with 520 major inquiries during the year. Approximately half of these were from manufacturers, and over one-third from Government departments and local authorities. Over 50 letters of appreciation were received, indicating that the service was proving of value.

The *Industrial Bulletin* is published jointly by this department and the Department of Industries and Commerce. This department's section comprised about 220 abstracts on research activities, engineering, chemistry, plastics, food industry, building, electricity, etc. Numerous requests were received for the original articles on which the abstracts were based.

SCIENTIFIC LIAISON SERVICE

The department maintains a Scientific Liaison Office in London and has a representative in Washington.

These officers are responsible for keeping New Zealand research institutions and workers advised of the most recent relevant and important scientific work being carried out overseas. This advance information assists the department in formulating and modifying its own research programmes and in avoiding duplication of the work undertaken elsewhere. The Liaison Officers have access to the results of a vast amount of research in progress, much of which is on a scale beyond the normal resources of smaller organizations. In addition, Liaison Officers provide answers to specific technical inquiries from New Zealand, maintain and establish contacts with appropriate overseas research organizations, obtain scientific reports and publications not otherwise readily available, represent the Dominion on specialist committees, assist scientific visitors from New Zealand, and act in an advisory capacity to other official New Zealand representatives overseas.

During the year the Assistant Scientific Liaison Officer, London, spent some three months in New Zealand on furlough and in bringing himself up to date on the most recent research activities of the department.

The department is greatly indebted to research organizations overseas for their helpfulness to our Scientific Liaison Officers.

In both London and Washington the association of the department's Scientific Liaison Office with the British Commonwealth Scientific Offices (B.C.S.O.) has greatly facilitated co-operation in scientific matters on a Commonwealth basis.

COMMONWEALTH AGRICULTURAL BUREAUX

Commonwealth collaboration in the field of scientific information was established some twenty-five years ago by the setting up of the Commonwealth Agricultural Bureaux (C.A.B.). The organization consists of ten Bureaux, three Institutes, and a Headquarters, all but one of which are located in the United Kingdom, but serve, in particular, all parts of the British Commonwealth.

The main functions of the C.A.B. are the preparation and publishing of journals containing abstracts of the world's scientific literature relating to agriculture and forestry, and the publishing of monographs on particular subjects in these fields. This and the other services of

the C.A.B. enable research workers to keep in touch with the very extensive literature on these subjects with the minimum of time and expense.

These services are of special value to New Zealand in view of the importance of these industries in our economic development.

Participating Commonwealth Governments contribute financially to the support of the Bureaux and the funds are augmented by the world-wide sale of the publications of the Bureaux. Each Bureau or Institute is represented in New Zealand by an Official Correspondent who is a specialist in the subject concerned. The organization as a whole is represented in New Zealand by the C.A.B. Liaison Officer, who is a member of the staff of this department.

GRANTS TO OTHER INSTITUTIONS

Apart from the incorporated research associations, grants were continued for research in the University (£27,045), and much valuable work is being undertaken. Such grants are closely co-ordinated with those made by the Research Committee of the University in order to avoid duplication and ensure the most efficient use of the funds available.

The grant to the Cawthron Institute was continued to enable the Institute to maintain its wide range of activities in the Nelson area and to undertake specialist chemical research in co-operation with departmental branches, such as the Tobacco and Hop Research Stations. The grant to the Royal Society of New Zealand was increased during the year to cover increased costs of printing and to assist the Society to fulfil its role as the senior scientific society in the Dominion.

CONCLUSION

The department has continued to receive generous co-operation from other State departments, the Cawthron Institute and the University colleges, overseas scientific organizations, and from both farming and manufacturing interests. The good relations that have prevailed have been much appreciated and have greatly assisted the promotion of the department's objectives.

In conclusion, I would thank the staff of the department for their help and co-operation during my first year in the new responsibilities of this office, and also express my personal indebtedness to the Council of Scientific and Industrial Research and its advisory committees for the assistance they have generously rendered on all occasions.

W. M. Hamilton, Secretary.

BRANCHES

ANIMAL ECOLOGY SECTION

Officer in Charge: Dr K. Wodzicki

PROJECTS

Research on Rabbits.—Reproduction: variations in reproductive activity in relation to season and environment. Parasites: analysis of parasite infestations in relation to age and sex of the host, and environmental factors; geographical distribution of three species of nematode worms of rabbits; and parasitic fauna of rabbits from sub-Antarctic islands (Macquarie and Auckland Islands groups). Other projects: growth studies on rabbits with a view to improving methods of age determination; census methods—dropping and sight counts (in co-operation with the Applied Mathematics Laboratory); study of a wild population (with marked individuals); nature and location of residual rabbit populations; fluctuations in rabbit populations (in co-operation with the Applied Mathematics Laboratory); rabbit predators (banding study of the harrier-hawk); effect of rabbits on pasture; and behaviour studies.

Studies on Other Animals.—Local surveys: mammals and birds of Western Taupo; and reconnaissance at Auckland Islands group. Bird census techniques. Investigation of magpies (*Gymnorhina hypoleuca* and *G. tibicen*). Distribution and taxonomy of kiore (*Rattus exulans*) in New Zealand. Life history, migration and dispersal, population trends, and behaviour of the gannet (*Sula serrator*).

PUBLICATIONS

Distribution of the Nematode *Trichostrongylus retortaeformis* (Zeder 1800) in the Wild Rabbit *Oryctolagus cuniculus* (L). *N.Z. J. Sci. Tech. B34*:449. P. C. Bull.

Observations on a Marked Population of Blackbirds at Lower Hutt. *Notornis 5*:149. P. C. Bull.

Ringing Operations Summary for the Year Ended 31 March 1953. *Notornis 5*:138. P. C. Bull.

A Bird Census and Some Recent Observations on Birds on the Great Island, Three Kings Group. *Rec. Auck. Mus. 4*:245. E. G. Turbott and P. C. Bull.

Aliens in the Forest. 3. The rats. *Forest and Bird* (Nov. 1953). J. S. Watson.

The Apophyseal Line as an Age Indicator for the Wild Rabbit *Oryctolagus cuniculus* (L.) *N.Z. J. Sci. Tech. B34*:427. J. S. Watson and C. H. Tyndale-Biscoe.

Notes on the Life History and Population Trends of the Gannet at the Plateau Gannetry, Cape Kidnappers. *Emu 53*:152. K. Wodzicki and Rev. F. H. Robertson.

Aliens in the Forest. 4. Weasel-like Animals. *Forest and Bird* (Aug. 1953). K. Wodzicki.

APPLIED MATHEMATICS LABORATORY

Director: Dr R. M. Williams

PROJECTS

The projects completed during the past year have been: analysis of seiche records; estimation and test theory for sampling in a plane under certain conditions; D.S.I.R. staff turnover survey (with Occupational Psychology Research Section); investigation of sampling schemes for correlated data; investigation of some statistical problems in auditing; graduate survey (with Occupational Psychology Research Section); analysis on punched cards of data on cosmic rays, fishing records, and heifer-twin records; and test theory for food tasting.

The projects under way are: investigations on interactions between rabbits, weather, and rabbit parasites; estimation of rabbit populations; statistical treatment of radio and magnetic data; investigation of configuration of interacting particles (for ecology, bacteriology, etc.); analysis of fertilizer and cold storage experiments on apples; analysis of chemical composition of coal samples; distribution of earthquakes in New Zealand; theory for comparison of variability in milk yields; confidence limits for percentile points points of flow levels of rivers; tests on mathematical "goodness-of-fit"; growth of aphid populations; analysis of measurements on deer; investigation of methods of analysis of rotational grazing trials; investigation of efficiencies of different types of design used in plant breeding; investigation of sources of error in pasture experimentation; and theoretical investigations into geothermal project (with Dominion Physical Laboratory).

In the foregoing projects, either all the work was done by this laboratory or a substantial statistical contribution was made; other work not mentioned were contributions to the projects of other organizations.

PUBLICATIONS

The Prediction of Floods. *N.Z. Engineering 9* (1) 1954. I. D. Dick and J. H. Darwin.

Population Differences Between Species Growing According to Simple Birth and Death Processes. *Biometrika 40* (3 and 4). J. H. Darwin.

Some Theory Relating to the Diffusion of Chemicals in Green Timber. *N.Z. J. Sci. Tech. 35* : 113–28. A. McNabb and W. B. Taylor.

The Efficiency of Some Experimental Designs Used in Doing Husbandry Experiments. *J. of Agric. Sci. 43* (4). W. B. Taylor and P. J. Armstrong.

A Note on Incomplete Block Designs With Row Balance. *Ann. Math. Stat. 24* (1). H. O. Hartley, S. S. Shriklande, and W. B. Taylor.

The Analysis of Multiple Stationary Time Series. *J. Roy. Stat. Soc.* (B) *15*. P. Whittle.

Estimation and Information in Stationary Time Series. *Ark. för Matematik 2*:423. P. Whittle.

AUCKLAND INDUSTRIAL DEVELOPMENT LABORATORIES

Director: Mr J. B. Brooke

PROJECTS

Fuel Technology.—Steam-flow measurements; boiler-efficiency tests; survey of instrumentation installation; evaluation of local fuels; and tests on deterioration of stored coal.

Technological Development Group.—Special heating elements for press; check on foundry sands; vibrograph measurements; shrinkage measurements on building blocks; rock-drilling tests; advice on newspaper-machine problems; material colour comparator; density control of brine for quality sorting of green peas; and photoelectric control of wrapping mechanisms.

Medical Instrumentation.—Extensive work has been carried out for the cardiac clinic, the obstetrics and gynaecology unit, and the anaesthetic department of the Auckland Hospital Board.

Design Section.—Investigations of vibrations on bridges; arsenic-powder injector for termite control work; tests on 30 ft. prestressed beam; design of wire-bending machine; development of magazine-wrapping machine; strip-bending press tools; investigation and report on a juice-extracting machine for citrus fruit; temperature measurements on chilled beef; leather-veneer machine; balancing brush roll for paper-making machine; determination of "E" values of concrete with strain gauges; and low-frequency mechanical oscillator for the Underwater Research Laboratory.

Physics Section.—Tests on fire-proofing materials; tests on banana shipments (in collaboration with the Dominion Laboratory); building vibrograph; work on geothermal projects; development of stainless-steel polishing techniques; investigating failure of refrigerators; vibration measurements; frost work at Plant Diseases Division; and checks on instrument installation at Kinleith.

Electrical Section.—Electronic relay for earth leakage protection on a railway high-tension line; design and specifications for sound-proofing room at School for Deaf; corrosion work for Navy; oscillator and amplifier for displacement transducer; and experimental heated blanket for glue curing.

Metallurgy Section.—Investigation of corrosion of stressed steel specimens; survey of buried pipe-line failures; foundry sand investigations; and testing of materials of construction.

BOTANY DIVISION

Director: Mr C. M. Smith

PROJECTS

The principal projects under way are given below:

Preparation of revised and third edition of Cheeseman's *Manual of New Zealand Flora;* preparation of a manual of New Zealand adventive plants; and preparation of a chromosome atlas of New Zealand plants (present special study—New Zealand gymnosperms).

Palynology: plant remains in Quaternary strata, melitopalynology, limnology, and atmospheric pollen records.

Systematy of New Zealand grasses; breeding and ecology of local forms of indigenous "Blue Grass" (*Agropyron scabrum*); and cultivation and breeding of *Phormium tenax.*

Ecology of South Island tussock grasslands: vegetational changes in progress at Molesworth Station, and growth and seasonal habits of species under trial as pasture introductions.

Maintenance and upkeep of herbaria: herbarium of indigenous plants, herbarium of adventive and cultivated plants, and seed herbarium.

Collection and distribution of seeds of indigenous plants and annual issue of an Index Seminum; and recording of introductions of seeds from overseas for scientific and commercial purposes.

Establishment in Canterbury of a botanic gardens for the conduct of the Division's observations and experimental work, and for maintenance of a reference collection of growing plant material.

Study of New Zealand freshwater plants and their distribution.

PUBLICATIONS

An Ecological Study of New Zealand Tussock Grassland. *Bulletin No. 107 D.S.I.R.* A. P. Barker.

Yellow Leaf Disease in Phormium. *N.Z. J. Agric.* (Aug. 1953). W. R. Boyce.

Studies in New Zealand Agropyron (Parts I and II). *N.Z. J. Sci. Tech. 35*:315–43. H. E. Connor.

Pollen Grains and Plant Taxonomy. *N.Z. Sci. Rev.* (June 1953). W. F. Harris.

Contributions to the Naturalized Flora, No. 3. *Trans. Roy. Soc. N.Z.* (May 1953). A. J. Healy.

Identification of Some Common Buttercups. *Proc. N.Z. Weeds Conf.* (Sept. 1953). A. J. Healy.

Identification and Distribution of Rushes in New Zealand. *Ibid.* (Sept. 1953). A. J. Healy.

Introduction and Spread of Weeds. *Ibid.* (1952). A. J. Healy.

Comparison of Gravity and Impact Methods of Collecting Spores, etc. *N.Z. J. Sci. Tech. 34*:378–83. R. V. Mirams.

Studies on the Coastal Dune Lakes of North Island of New Zealand. *Austr. J. Marine and Fresh Water Research* (1953). N. T. Moar *et al.*

Cliff Plants. *Post. Prim. School Bull. of N.Z. Education Dept.* (April 1953). L. B. Moore.

Fused Needle Disease of Pines. *Emp. For. Rev.* (Sept. 1953). C. M. Smith.

"Index Seminum Anno MCMLIII Collectorum" (May 1953). *Divisional Publication.*

CROP RESEARCH DIVISION

Director: Dr E. J. Godley

FIELD-CROP PROJECTS

Wheat.—Breeding for the following: a general-purpose wheat of Cross 7 type with higher yields; an early-maturing variety that will not lodge, to replace Tainui in the North Island; a high-yielding wheat with stiff straw and tight chaff for high-fertility land where Dreadnought is grown; a high-quality wheat with higher yields than Hilgendorf; lines of commercial varieties resistant to mildew; and spring wheat suitable for mid-Canterbury.

Wheat Genetics Studies.—Inheritance of kernel weight; grain-shattering; protein; mildew-resistance; and yield studies of varietal mixtures.

Wheat Disease Survey.—Annual surveys, for five years, of a representative sample of Canterbury wheat crops.

Oat Breeding.—Lodging-resistant milling oats; lines of commercial varieties resistant to crown rust; and introduction and testing of promising overseas varieties.

Barley.—Work confined to the introduction and testing of new overseas varieties.

Potato Breeding.—Resistance to blight (*Phytophthora infestans*); resistance to viruses X, Y and leafroll; and improved agronomic characters.

Virus-free Stocks of Potatoes.—Selection of virus-free plants of commercial varieties and maintenance of nucleus stocks; and annual testing of virus-free stocks that are being increased by the Department of Agriculture.

Potato Virus Diseases.—Study of the natural spread of virus diseases; methods of control of virus; methods of testing for virus content and virus resistance; study of the nature of resistance and of gene action; and the effect of environment upon resistance.

Potato Blight.—Study of blight strains in New Zealand and of their origin; study of the nature of resistance and of gene action; and the effect of environment upon resistance.

General.—Investigation of strain differences in Aucklander Short Top; and the effect of sprout inhibitors upon potato tubers for table and for seed.

Swedes.—Breeding for resistance to dry-rot and club-root; and investigation of resistance to aphids.

Rape.—Breeding for resistance to aphids by crossing with resistant swedes; and breeding for improved agronomic features in club-root resistant rape.

Lucerne.—Breeding for an improved grazing type of lucerne.

Linseed.—Producing rust-resistant varieties by testing introductions, selection within present commercial varieties, and by transferring resistance to commercial varieties; and obtaining pasmo-resistant and browning-resistant varieties as above.

Linen Flax.—The transference of rust-immunity to Liral Crown and Concurrent by hybridization and back-crossing; and obtaining lodging-resistant material by testing introductions.

Lupins.—Investigations of factors affecting pod-setting; assembling wild material from other countries to obtain types with large numbers of small seeds, for use in increasing seed production; and breeding a yellow lupin with non-shattering and non-bursting pods with an improved seed yield.

VEGETABLE PROJECTS

Dwarf Beans.—Breeding for halo-blight resistance; and estimation of the amount of natural crossing.

Pole Beans.—Breeding for rust-resistance; and selection and comparison of strains of the variety Fardenlosa.

Tomatoes.—Improvement of fruit shape in Mangere Pale-leaf; a search for resistance to spotted wilt in a promising cross, Pearl Harbour × Rey de los temprana; the influence of the maternal parent on yield in hybrid tomatoes; investigations into the production and use of first generation hybrids in outdoor tomatoes; and the use of hormone fruit-setting sprays on outdoor tomatoes (with Fruit Research Station).

Savoy Cabbage.—The production of uniform early-maturing and late-maturing strains in the variety Best of All; and an investigation into the use of hive bees in glasshouses to aid production of pure seed.

Spring Cabbage.—The development of a uniform strain of the variety "Flower of Spring".

Cauliflower.—The development of strains of winter cauliflower, with improved yield and uniformity in maturing time.

Carrots.—Selection in "Holmes Improved" to provide a table carrot of good eating quality and yield.

Peas.—The inheritance of immunity to the pea mosaic virus; and the effect of the rogue character on seed characters in Onward peas.

NUCLEUS SEED PRODUCTION

Each year pure seed of some forty crop varieties is produced, to provide nucleus seed for the seed certification scheme of the Department of Agriculture.

AGRONOMY PROJECTS

Crop Ecology

Preparation of a map of the major environmental factors for the main cropping regions.

Forage Crop Measurement Techniques

Lamb-fattening Forages.—Measurement of total crop weight, stubble loss, grazing loss, weight of feed consumed, together with digestibility, and live weight increase of grazing wethers.

Cereal Greenfeeds.—Measurement of yield under a mowing technique, Lynch's herbage return technique, and Sear's proportionate return of dung and urine technique, using N.I.A.B. ryecorn and Winter Grey Oats.

Yield Trials

Lamb-fattening Forages.—Species: Broad Leaf Essex II rape *v.* Borre lupin. Row spacing: rape at 7 in. centres *v.* 21 in. centres and inter-cultivation.

Cereal Greenfeeds.—Species: summer sown cereal species, ryecorn, Wong barley, Dun oats, and Dreadnought wheat. Seed rate: N.I.A.B. ryecorn; low, normal, and high.

Growth Rate Trial.—Time of sowing, interval between cuttings, and number of cuttings on forage and seed yield of N.I.A.B. ryecorn and Winter Grey oats.

Legume - Non-Legume Crop Associations and Nitrogen Top-dressing

Broad Leaf Essex II rape and Borre lupin; cereal greenfeeds with Broad Red and Crimson clovers and Serradella; and sulphate of ammonia at sowing and in April with cereal greenfeeds.

N.I.A.B. Ryecorn Improvement

Polycross block and progeny testing followed by seed increase of selected lines to provide nucleus seed for certification.

Rust of Cereal Greenfeeds

Pot studies of the effect of rust on the yields of greenfeed. Provision of rusted and non-rusted Dun oats for chemical analyses and animal nutrition experiments.

Recovery of Greenfeeds After Grazing

The relationship between growth characteristics, cutting heights, and recovery after cutting.

Legume Collection

Eighty lines comprising twenty or more species for suitability in mixtures with cereal greenfeeds.

PUBLICATIONS

Progressive Improvement in Self-fertilized Crops. *Heredity* 7:127–9. T. P. Palmer.

Resistance of Swedes to Aphids. I. Resistant Varieties. *N.Z. J. Sci. Tech. A34*:553–5. T. P. Palmer.

Breeding Better Wheats. *N.Z. Baker and Confectioner* (Nov. 1953), 1–4. L. G. L. Copp.

The Effect of Variety, Storage and Locality on the Ascorbic Acid Content of the Potato Tuber. *J. Sci. Food and Agric., 4*:386–96. R. M. Allison and C. M. Driver.

New Zealand Wheat Review, 1950–51–52.

DOMINION LABORATORY

Director: Mr F. J. T. Grigg

PROJECTS

Chemical Engineering.—Dehydration of meat; utilization of surplus citrus fruit; transport of bananas; design of tobacco kiln; manufacture of fused phosphate fertilizer; utilization of geothermal steam; phosphorized-pollard plant; fuel technology and boiler efficiency; and removal of sulphur from coal gas.

Coal.—Analyses of coal for the Geological Survey and the Mines Department; and analyses of gases and air from mines.

Petroleum and Highways Materials.—Analysis of lubricating oils, fuels, and other petroleum products; and analysis of bituminous road materials and tars.

Physical Chemistry.—Spectrographic examinations of metals, etc.; X-ray examinations of crystals; "dimpling" of photographic emulsions; vapour-pressure measurements on sea-water during evaporation; spontaneous ignition of wool cargoes; phase-rule studies on borate solutions; investigations on analysis of photographic developers; development of electrolytic descaling process; and infra-red spectrographs.

Metallurgy and Corrosion.—Chemical analysis of metals and alloys; investigations of corrosion of metals; investigations of corrosion in water-cooling system of radio transmitter; investigation of metals in Geiger counters; corrosive properties of geothermal steam; and corrosion by top-dressing materials in aircraft.

Geothermal Chemistry.—Sampling and analysis of gases, condensates, and waters from hot springs and geothermal bores.

Minerals and Building Materials.—Analysis of rocks, minerals, and ores, portland cements, and concrete products (tiles, etc.); assay of samples for gold and silver; investigation of rocks for use as perlite; analyses of fused phosphate fertilizers; investigation of pozzolanas and concretes containing pozzolanas; heat of hydration of cements; and examination of aggregates for concrete.

Isotopes.—Determination of age of specimens by radioactive carbon; handling of radioactive phosphorus and iodine for hospitals; study of origin of sulphur in coal by means of isotope ratios; survey of ratio of deuterium to hydrogen in waters from thermal bores and from glaciers; and determination of ratios of nitrogen isotopes in apple trees, and in grasses and clovers.

Food and Drugs.—Analysis of food, water, and drugs; advice to Health Department on chemical matters; and bacteriology of food and water.

Meat Research.—Dehydration of beef; study of muscle proteins; survey of transport of beef; investigation of bone taint; and investigation of methods of bacon curing.

General Section.—Analysis of pesticides; spray-residue investigations; examination of police specimens; photographic work; examination of town gas; and industrial hygiene.

Organic and Wood Chemistry.—Investigation of extractives of Douglas fir; analysis of toxicological specimens; spontaneous combustion of wool (with Physical Chemistry Section); and wood chemistry.

Paint.—Analysis of paints; paint test investigations; and research on paint problems.

District Laboratories

Auckland.—Analysis of food and drugs; bacteriological survey of Waitemata Harbour; toxicology; chemical analysis of timber preservatives and treated timber; and examination of town gas.

Christchurch.—Analysis of food and drugs; bacteriological and chemical survey of Avon and Heathcote rivers and estuary; toxicology; and examination of town gas.

Dunedin.—Analysis of food and drugs; toxicology; and examination of town gas.

PUBLICATIONS

The Differential Thermal Analysis of Coal. *Fuel 32* (No. 4, 1953), J. B. Stott and O. J. Baker.

The Preparation of Carbon for C^{14} Age Measurements. *N.Z. J. Sci. Tech. B35*:64–89. T. A. Rafter.

New Zealand C^{14} Age Measurements (Part I). *Ibid. B35*:127–28. G. J. Ferguson and T. A. Rafter.

The Selenium Content of Apples: *Ibid. B34*:245–7. P. J. C. Clark, H. E. Barr, A. P. Camden-Cooke, and H. Jacks.

The Chemical Investigation of the Hot Springs of the New Zealand Thermal Region. *Proc. S. Pacific Sci. Cong. 2 (Geology)*:449–69. S. H. J. Wilson.

Bacteriological Survey of Auckland Harbours (Part I). *N.Z. J. Sci. Tech. B34*:515. G. M. Wallace and L. E. Newman.

Bacteriological Survey of Auckland Harbours (Part II). *Ibid. B35*:225. G. M. Wallace and L. E. Newman.

DOMINION PHYSICAL LABORATORY

Acting Director: Mr I. D. Dick (Assistant Secretary)

PROJECTS

Establishment of Standards of Physical Measurement.—Length: New Zealand principal standard measure; engineering length standards by interferometry; and tape standards and facilities for survey-tape calibrations.

Mass: New Zealand principal standard measure; Laboratory standards; balances in range up to 100 kg.; and hydrostatic balance for density determinations and calibration of hydrometers, etc.

Temperature: Realize International Temperature Scale from fixed points; and Laboratory standards.

Barometry and Pressure: Normal barometer; secondary standards; and re-establish hydrostatic pressure standards in range up to 20,000 lb.

Photometry and radiation: Photometric standards (lamps); spectrophotometric standards; colorimetric standards; radiometry; and participation in affairs of the International Commission of Illumination.

Air Velocity.—Instruments and facilities for the calibration of anemometers in the range up to 3,000 ft. per minute.

General Acoustic Equipment.—Setting up and maintenance of equipment for acoustic tests.

General Frequency Measurements.—Running, developing, and using the frequency standard.

Electrical Standards

Primary Standards.—Five 1-ohm coils and six Weston cells maintained at a constant temperature and intercompared on apparatus to be developed at D.P.L.

Working Standards, D.C.—Resistance: sub-standard resistance and bridges; accuracy 1 in 10^4 to 1 in 10^5. Current, etc.: potentiometer, shunts, etc.; accuracy 1 in 10^4 to 1 in 10^5.

A.C./D.C. Transfer.—Power, etc: N.P.L.-pattern electrostatic voltmeter; non-inductive resistors. Impedance: finally a bridge comparing C with R at a known frequency; meanwhile, stable inductors and condensers.

Working Standards, A.C.—Power, etc.: Cambridge dynamometer and non-inductive resistors. Impedance: the inductors and condensers of A.C./D.C. transfer and A.C. bridges with sources and detectors; frequency range 10 c/s to audio and if necessary to 100 kc/s.

Radio Standards.—Power: at frequencies up to about 100 mc/s the standard is to be one of several forms of square-law voltmeter that can be calibrated with D.C.; at higher frequencies power is to be compared directly with low-frequency or D.C. power on a bolometer bridge; high powers are to be measured on calorimeters.

Mechanical Engineering

Strong-motion seismograph (type EB): a seismograph for recording strong-motion earthquakes at various places in New Zealand to obtain information on characteristics of such earthquakes.

Analysis of earthquake damage: analysis of damage caused by the Cheviot and other severe earthquakes; data will be obtained from claims held by Earthquake and War Damage Commission.

Tests on pre-stressed concrete reservoir: measurement of stress in steel pre-stressing wire, and in concrete, at a number of points on a pre-stressed concrete reservoir at Upper Hutt (for Ministry of Works).

Otahuhu Substation control building—strains and soil pressure: measurements of strains in concrete and reinforcing steel and soil pressures under building (for Ministry of Works).

Survey of New Zealand foundry practice: a critical summary of the foundry industry will be written when the survey is completed.

Investigation of effect of weld defects on mechanical properties: to ascertain the influence of several types of common welding defects on the mechanical strength of welded joints in mild steel (research project).

Experimental seed drill: design and manufacture of a machine which will sow seed to an accuracy of $\pm 5\%$ (for Extension Division of Department of Agriculture).

Grass-mowing machine: machine to cut experimental plots without chopping the grass (Department of Agriculture).

Vertical velocity touch-down recorder: instrument required for statistical study of forces acting on aircraft undercarriage. Specification requires automatic recordings of 200 landings, vertical velocities up to 20 ft./sec., and weight not exceeding 10 lb. (for R.A.E.).

Geothermal

Heat exchange investigation: includes work on various aspects of heavy water project, parts for corrosion tests, and special instruments for measuring densities and flows of steam/water mixtures.

Physics of the thermal area: systematic measurements of temperatures and flows, and other factors, from selected hot springs, geysers, etc., in Wairakei Valley, Waiotapu, Orakeikorako, and in the Kuirau Reserve, Rotorua.

Measurement of water content of steam: measurement of total water output of bores at Wairakei, using a gamma source of radiation.

Geyser action: an attempt to correlate quantitatively data on typical New Zealand geysers with current theory of geyser action.

Two phase fluid flow: a long-term fundamental investigation related to the geothermal power project.

Concrete Investigations

The investigation of the value of the Middlemarch, Whirinaki, Kaimai, and Kopokorahi pozzolanic deposits for the manufacture of concrete.

Radio

Radio path investigation: research sponsored by the Radio Research Committee; investigation of the absorption of high-frequency radio energy on short (single-hop) paths in order to improve prediction of lowest usable high frequency.

Measurements of Rapid Fading of Ionospheric Signals and Ionospheric Winds

Cook Strait propagation: investigation of propagation conditions in Cook Strait region at a number of frequencies between 300 mc/s and 3,000 mc/s.

Noise source: development of measuring instruments using discharge lamps as calibrators for cm. receivers.

Construction of panoramic ionospheric sounder: new equipment for Geophysical Observatory, Christchurch, to permit quick and frequent observation of ionosphere conditions.

Optical Design

Describe optical design methods: description of application of theoretical results to practical design of optical systems.

Investigation of properties of optical materials: collection of information on the refractive index and other significant properties of optical glasses and of natural and synthetic colourless transparent cubic crystals.

Design of general purpose aplanats: this project aims at determining suitable stock designs; many lens systems can be built from a few stock designs with a little modification.

Projects Entailing the Application of Physical Methods for Biological and Agricultural Problems

Electron Microscopy.—Spermatozoa from bulls: comparison of morphologies of sperm from bulls of high and lower fertility (for Animal Research Station, Ruakura).

Tobacco mosaic virus: determination of virus particle concentration in saps from infected plants.

Human dentine: extension of knowledge of the structure of teeth (in conjunction with Dental School, University of Otago).

Streptomycetes: assistance to Plant Diseases Division in compiling and census of soil fungi.

Heat Production by Bull Sperm.—The work was originally to find an improved assay method for bull sperm; it is now a straight-out study of heat production by a micro-organism.

Ultraviolet Radiation Integrator.—Equipment developed for Department of Agriculture to enable ultraviolet radiation received at different sites to be recorded, integrated, and compared.

Age by C^{14} Determination.—Determination of age of carbonaceous material between 200 and 20,000 years.

Soil Moisture Measurement.—Measurement of water content of soils by neutron scattering.

Medical Work for Hospitals.—Standardization and measurements involved in use of P^{32} and I^{131} for medical purposes.

Soil Radioactivity Survey.—Survey of radioactivity of soils being done in conjunction with Soil Bureau.

Nitrogen Metabolism of Apple Trees.—N^{15} labelled KNO_3 fed to seedlings and path of N^{15} followed (in conjunction with Dominion Laboratory and Fruit Research Station).

Nitrogen Economy of Grass/Legume Associations.—N^{15} labelled compounds fed to grass, clover, and grass and clover in pots, and path of N^{15} followed.

Plant Physics.—Development of special equipment to measure soil temperatures and soil moisture for Grasslands Division, to gain more information on conditions necessary for plant growth.

PUBLICATIONS

A Variable Setting Frost Alarm. *J. Hortic. Science 28* (No. 3). H. R. Hart.

Spectral Distribution of Radiation from Sun and Sky. *Trans. Illum. Eng. Soc. 19* (No. 1). J. N. Hull.

Spectrophotometry of Radiation from Sun and Sky. *Ibid. 19.* E. R. Cooper and M. C. Probine.

Heat Losses from Buildings. *J. N.Z. Inst. Arch.* (June and Nov. 1953). L. Bastings.

Activity Measurement of Samples for Radiocarbon Dating. *N.Z. J. Sci. Tech. B35*:90–108. G. J. Fergusson.

New Zealand C^{14} Age Measurements, II. *Ibid. B35*:127–8. G. J. Fergusson and T. A. Rafter.

The Calorimetry of Solid-fuel Domestic Stoves. *J. Inst. Heating & Ventilating Eng.* (July 1953). L. Bastings and R. F. Benseman.

A Mobile Strain Recording Equipment. *N.Z. Engineering 8*:232. J. B. C. Taylor and R. E. Belin.

Methods of Measuring Strain in Concrete Beams. *Ibid. 8*:90. J. B. C. Taylor.

Non-destructive Testing—X-ray and Gamma Ray. *N.Z. Manufacturer* (Sept. 1953). L. H. Davenport.

Non-destructive Testing—Magnetic Fields and Ultrasonic Waves. *Ibid.* (Oct. 1953). P. F. Tomalin.

The Application of High Frequency Radio Propagation Predictions in the New Zealand Area. *N.Z. J. Sci. Tech. B35*:198–212. G. McK. Allcock.

The Use of Gaseous Discharges as Microwave Noise Sources. *Physics Section of Royal Society* (Oct. 1953). G. W. G. Court and R. I. Skinner.

Uses of Isotopes in Industry. *N.Z. Manufacturer* (July 1953). J. T. O'Leary.

ENTOMOLOGICAL RESEARCH STATION

Director: Dr D. Miller

MAIN PROJECTS

Grass-grub and *Oxycanus* investigations (exclusive of insect parasites); manuka-blight; insect parasites of grass-grub; collection, breeding, and distribution of egg parasites of green vegetable-bug; importation of parasites of the clover-case bearer *Coleophora* spp.; investigation on the entomological phases of "yellow-leaf" in *Phormium; Bibliography of New Zealand Entomology;* seed-set in red clover with special reference to insect pollinators; *The Biology of Bumblebees in New Zealand;* maintenance and development of insect reference collection; *Systematic Catalogue of the Coleoptera of New Zealand;* and identification service and advice concerning control of insect pests.

OTHER PROJECTS

Control of pests in stored products and households; survey to determine significance in pastures of *Aphodius howitti;* effect of insects on tussock grassland; survey to determine damage caused by *Heteronychus sanctae-helenae;* study on biology and control of slugs in crops and pastures; investigation of *Catoptes* sp., a weevil recorded on crucifers and on pasture; control of collembola harmful to crucifers in the cotyledon stage; control of the mite *Cnemidocoptes mutans* causing "scaly leg" of poultry in poultry houses; importation into Cook Islands of natural enemies of citrus rust mite and the purple scale *Lepidosaphes beckii;* search for parasites of apple leaf-curling midge *Dasyneura mali;* search for parasites of oak leaf miner *Lithocolletes messaniella;* grass-grub damage in raspberries; investigations on *Nysius huttoni,* one of the causes of "sticky dough" in wheat; distribution of *Rhyssa* parasites of *Sirex noctilio;* ectoparasites of birds and some mammals in New Zealand; *A Catalogue of the Thynninae (Tiphiidae, Hymenoptera) of Australia and Adjacent Areas* (completed); a survey of the economic importance of insects in lucerne (in abeyance); and control of soil collembola (in abeyance).

PUBLICATIONS

A Preliminary Note on the Control of *Cnemidocoptes mutans* Robin. *N.Z. Ent. 1 (3)*:17–8. J. W. Cleland.

Aphids of New Zealand. *Bulletin No. 106 D.S.I.R.,* xi, 382 pp. W. Cottier.

Life-cycle of the Humble Bee. *N.Z. Sci. Rev. 11*:92–8. R. A. Cumber.

Die-back Condition of *Phormium* Seedlings Used in Yellow-Leaf Investigations. *N.Z. J. Sci. Tech. A35*:270–2. R. A. Cumber.

Grass-grub Populations in Soils of the Manawatu Sand Country. *Ibid. A35*:465–70. R. A. Cumber and J. D. Cowie.

A Catalogue of the Thynninae (Tiphiidae, Hymenoptera) of Australia and Adjacent Areas. *Dept. S. & I. R. Bull. 109*. B. B. Given.

Notes on Australian Thynninae. 1. *Ariphron bicolor* Erichson. *Proc. Linn. Soc. N.S.W. 78*:5–6. B. B. Given.

Notes on Melolonthinae (Coleoptera). 1. *N.Z. Ent. 1 (3)*:18–20. B. B. Given.

The Strepsiptera, an Insect Order new to New Zealand. *Ibid. 1 (3)*: 3–8 E. S. Gourlay.

A Note on the Occurrence of *Linguatula serrata* (Frohlich, 1789) in the Wild Rabbit *Oryctolagus cuniculus* in New Zealand. *N.Z. J. Sci. Tech. B35*:49–50. L. Gurr.

A Recent Attempt to Introduce Virginian Quail Into New Zealand. *Notornis 5*:164. L. Gurr.

Some Remarks on the Possible Insect Vectors of Myxomatosis in New Zealand. *N.Z. Sci. Rev. 11*:81–2. L. Gurr.

A Note on the Breeding Age of Red-billed Gulls (*Larus novaehollandiae scopulinus*) at Nelson, N.Z. *Notornis 5*:185. L. Gurr.

The Chukor in New Zealand. *Emu 53*:283–90. L. Gurr and B. J. Marples.

Some Insect Food of Nestling Red-billed Gulls (*Larus novaehollandiae scopulinus*). *Notornis 5*:208–9. L. Gurr.

First Record of Occurrence of *Eriococcus leptospermi* in New Zealand. *N.Z. Ent. 1 (3)*:1. J. M. Hoy.

Effect of Some Hydrocarbon Insecticides on Earthworms. *Ibid. 1 (3)*: 22–3. J. M. Hoy.

A Note on Control of *Penthaleus major* Duges in Oats. *Ibid. 1 (3)*:17. J. M. Kelsey.

Supplementary Termites and Termite Control. *N.Z. Sci. Rev. 1* (No. 1–2). J. M. Kelsey.

Some Ramifications of a Chemical Control Project. *Ibid. 11 (8)*:103–5. J. M. Kelsey.

Current Research at Entomological Research Station, Ashburton. *An. Rev. Fed. Farmers N.Z.* (1953). J. M. Kelsey.

Pasture Pests. *Dairyfarmers Annual* (1953). J. M. Kelsey.

Hyperkeratosis and Other Complications in Animals. *N.Z. Vet. J. 1 (5)*. J. M. Kelsey.

Phytotoxic Effects of Insecticides Recommended for Grassgrub Control. *N.Z. Sc. Rev. 11 (8)*:101–2. A. D. Lowe.

FATS RESEARCH LABORATORY

Director: Dr F. B. Shorland

PROJECTS

General Investigations on the Composition of Animal Fats, With Special Reference to Those of Meat and Butter.—Isolation and identification of minor constituents: branched-chain fatty acids; unsaturated fatty acids; trans acids; lower fatty acids; and unsaponifiable constituents. Fatty acid composition: the fats of beef and mutton carcasses, etc., and comparison between fatty acid composition of animal fats and

those of pasture. Glyceride structure, with special reference to butterfat: investigation and development of suitable methods for studying seasonal changes in New Zealand butterfat.

Nutritive Value of Minor Constituents of Animal Fats.—Fatty acid composition of depot fats of rats fed branched-chain fatty acids, etc. (in association with the Nutrition Research Department of the Medical Research Council, Otago Medical School).

Nature of Meat Phospholipids.—Methods of extraction and purification; development of suitable methods for determining nitrogen, phosphorus, choline, ethanolamine, etc.; and fatty acid composition.

Industrial Utilization of Fats.—Manufacture of monoglycerides; studies on methods of splitting fats; analysis of tall oil with a view to suggesting possible industrial uses; manufacture of ethyl esters of tallow; and deactivation of trace metals in fats with a view to increasing stability.

Development of Techniques for the Investigation of Fats, Analytical Procedures, etc.—Gas-liquid partition chromatography: improved methods for the detection and estimation of fatty acids (from C_{10}–C_{22}) or their methyl esters; development of improved techniques for the investigation of the nature of highly unsaturated fatty acids by ozonolysis in association with gas-liquid partition chromatography; development of colorimetric techniques for the evaluation of peroxides in fresh tissues of meat, etc., and in the presence of phospholipids; development of rapid methods for the assay of glycerol and monoglycerides; and determination of glyceride structure.

Miscellaneous.—Stability of vitamin A in poultry feeds.

PUBLICATIONS

Fats and New Zealand's Economy. *Food Manuf.* (1953) *18*:21–6. F. B. Shorland.

A Compact Reflux Head for a Large Fractionating Column. *J. Sci. Inst.* (1953) *30*:172. J. S. George.

New Zealand Fish Oils, 6. Seasonal Variations in the Composition of New Zealand Groper (*Polyprion oxygeneios*) Liver Oil. *Biochem. J.* (1953) *54*:673–7. F. B. Shorland.

Animal Fats; Recent Researches in the Fats Research Laboratory, D.S.I.R., New Zealand. *J. Sci. Food and Agric.* (1953) *4*:497–502. F. B. Shorland.

A.O.C.S. Commentary. *J. Amer. Oil Chem. Soc.* (1953) *30* (No. 7):4. F. B. Shorland.

The Occurrence of n-Decanoic Acid in Mutton Fat. *Biochem. J.* (1953) *54*:14–6. R. P. Hansen and N. J. Cooke.

The Branched-chain Fatty Acids of Mutton Fat. 2. The Isolation of (+)-12-Methyltetradecanoic Acid and of 13-Methyltetradecanoic Acid. *Ibid.* (1953) *53*:374–8. R. P. Hansen, F. B. Shorland, and N. J. Cooke.

Branched-chain Fatty Acids of Mutton Fat. Isolation of a Liquid Saturated C_{17} Branched-chain Acid. *Chem. and Ind.* (1953):516–7. R. P. Hansen, F. B. Shorland, and N. J. Cooke.

The Branched-chain Fatty Acids of Butterfat. 3. Further Investigations on a Multibranched C_{20} Saturated Fatty Acid Fraction. *Biochem. J.* (1953) *55*:662–3. R. P. Hansen, F. B. Shorland, and N. J. Cooke.

Rapid Determination of Glycerol by the Potassium Periodate Method. *J. Appld. Chem.* (1953) *3*:308–11. L. Hartman.

Effect of Temperature on the Twitchell Fat-splitting Process and Its Catalysts. *J. Amer. Oil Chem. Soc.* (1953) *30*:349–50. L. Hartman.

Non-toxic Stabilized for Animal Fats. *J. Sci. Food & Agric.* (1953) *4*:430–3. L. Hartman.

Stability of Edible Tallow from Mutton and Beef. II. Suppression of the Deleterious Effects of Trace Metals. *N.Z. J. Sci. Tech. B35*: 254–8. L. Hartman and M. D. L. White.

Colorimetric Estimation of Fat Peroxides in Meat. *Ibid. B35*:307–10. L. Hartman, C. N. Hooker, and H. E. Watt.

FRUIT RESEARCH STATION

Director: Mr J. D. Atkinson

PROJECTS

Plant Hormones.—Routine maintenance of plant hormone certification scheme; control of *Botrytis* infection following use of hormones (with Plant Diseases Division); causes of fruit hollowing in tomatoes; attempts to control December drop in Cox's Orange apples; testing growth-inhibiting materials as an aid to early fruiting in excessively vigorous trees; hastening maturity of apricots to spread the picking period; and methods of improving storage quality of tree tomatoes by treatment of the stalks to prevent wilting.

Chemical Thinning.—Determination of the timing and concentration of various materials required to effect satisfactory thinning of different apple varieties; compatibility of thinning materials with therapeutants; measurement of the effect of chemical thinning on biennial bearing; and effect of DNC on bees.

Plant Nutrition.—Diagnosis and treatment of deficiency diseases. Tissue testing of apple foliage for major nutrients.

Analysing results from long-term manurial trials at Appleby; maintenance of large manurial blocks at Appleby and Hastings, with smaller blocks at Earnscleugh; and testing of foliar application as a method of manuring fruit trees.

Soil sterilization as a method of solving the problem of replanting apple trees in old tree sites (with Plant Diseases Division). Investigation of nitrogen metabolism of apple and other fruit trees.

Testing grassing down of apple blocks as a method of management. Measuring effect of contour planting on growth and yield of apple trees on Moutere hill slopes.

Frost.—Testing new devices suggested for frost control; measurement of temperatures dangerous to various fruits; and measurement of microclimates under frost conditions.

Fruit Storage.—Measuring the effect of chemical thinning on storage quality; attempts to control superficial scald on several apple varieties; measuring the relative keeping quality of "king" and lateral fruits on spurs; and checking variation between flesh temperature of apples and temperature of air surrounding them in cool store.

Testing relative keeping quality of Hastings and Nelson Sturmers. Determination of storage conditions required for Omega plums. Effects of manurial programmes on storage quality of Hastings apples.

Variety Investigations.—At Havelock North, 730 apple varieties are under trial; at Nelson and Loburn, promising varieties have been top worked; and pear, peach, and apricot variety trials are in process of establishment.

Citrus varieties of possible value to New Zealand have been introduced from Asia; trials of improved Chinese gooseberries, feijoas, and avocados have been started; and specimens of Naranjilla (*Solanum quitoense*), oyster nut (*Telfairea pedata*), Macadamia nut, and Litchi have been introduced for trial under New Zealand conditions. Causes of shy bearing in Purple King plums are being studied.

Rootstock Investigations.—Apple blocks to test a selected range of new rootstocks developed abroad have been established at Oratia, Havelock North, Appleby, Loburn, and Earnscleugh. *Phytophthora* resistance trials are in progress at Oratia.

A pear rootstock block has been planted at Havelock North; peach and plum rootstock trials at Oratia are reaching maturity; and an English plum rootstock trial is established at Earnscleugh. Rootstock trials of standard lemon, sweet orange, and New Zealand grapefruit are in being at the Oratia Research Orchard.

Propagation Methods.—Methods of raising apricot seedlings and ways of improving bud-take-in apricots on apricot stocks are in progress. Methods of storing and transporting sweet orange seed from the Cook Islands are being investigated.

Pruning.—Studies are being made on methods of handling very vigorous and weak growing apple trees.

Fruit Descriptions.—The effect of locality on fruit shape, colour, and period of ripening is being studied; and the pomological descriptions for local varieties are being prepared.

Virus Diseases.—In co-operation with the Plant Diseases Division, virus diseases in apples, pears, peaches, plums, cherries, apricots, oranges, lemons, and New Zealand grapefruit are being identified; and the selection of healthy budwood trees and roguing of rootstocks is being carried out.

PUBLICATIONS

Note on Manganese Deficiency in Apple, Plum and Quince. *N.Z. J. Sci. Tech. A35*:19–21. J. D. Atkinson and E. G. Bollard.

Fruit Research in New Zealand—General Review. *Orchardist of N.Z. 26*:19–23 and *26*:7–9. J. D. Atkinson.

Certification of Plant Hormones. 5th List. *Ibid.* 27:29. J. D. Atkinson.

Nitrogen Metabolism of Apple Trees. *Nature 171*:571. E. G. Bollard.

The Use of Tracheal Sap in the Study of Apple Tree Nutrition. *J. Exp. Bot. 4*:363–8. E. G. Bollard.

Zinc Deficiency in Pears. *N.Z. J. Sci. Tech. A34*:548–50. E. G. Bollard.

Zinc Deficiency in Peaches and Nectarines. *Ibid. A35*:15–18. E. G. Bollard.

Severe Potash Deficiency in Young Peach Trees. *Ibid. A35*:39–44. E. G. Bollard.

Note on Internal Browning of Quince Fruits. *Ibid. A35*:63–4. E. G. Bollard.

Chemical Thinning of Apples in Hawke's Bay. *Orchardist of N.Z. 26*:5–7. R. M. Davison and R. E. Robbins.

Peach Rootstocks: A comparison of Brompton Plum and Seedling Peach. *Ibid. 26*:19–21. A. Farmer.

Influence of a Naphthaleneacetic Acid on the Preharvest Drop of Jonathan Apples. *N.Z. J. Sci. Tech. A35*:45–62. D. W. McKenzie.

I. Effect of Repeated Applications on Preharvest Drop and Quality.

II. The Effect of a Single Application on Respiration Rate of Fruit During Storage.

III. Note on the Effect of a Single Application on Respiration Rate of Fruit on the Tree.

The Problem of Gnarling or Flat Limb in Gravenstein Apples. *Orchardist of N.Z. 26*:2–3. D. W. McKenzie.

Refrigerated Gas Storage of Apples in New Zealand. *N.Z. J. Sci. Tech. B34*:462–502. C. A. S. Padfield and J. L. Mandeno.

I. Equipment and Experimental Procedure.

II. Variety Jonathan.

III. Variety Sturmer.

Refrigerated Gas Storage of Apples in New Zealand. *Ibid. B34*:503–14. C. A. S. Padfield.

IV. Variety Granny Smith.

Effects of Delay Between Harvesting and Cool Storing on Sturmer Pippin Apples. *Ibid. A35*:152–8. C. A. S. Padfield.

Experiments With Sturmer Apples. *Orchardist of N.Z. 26*:31. C. A. S. Padfield.

GEOLOGICAL SURVEY

Director: Dr L. I. Grange

PROJECTS

Regional Geologic Surveys.—North Auckland, lower Waikato, Rotorua, Hawke's Bay, North Canterbury, West Coast - Nelson, Southland, and Fiordland.

Ground and Surface-water Supply.—Investigations at North Auckland, Waikato, Hawke's Bay, Canterbury, and Southland.

Coal Resources.—North Auckland, Huntly, West Coast, Kaitangata, and Ohai coalfields.

Agricultural Limestone.—Coromandel, Taurewa (near National Park), and Southland.

River Control.—Hawke's Bay.

Dam Sites and Hydro-electric Projects.—Atiamuri, Ohakune, Whakamaru, Aratiatia, Huka Falls, Kaituna, Braeburn, Roxburgh.

Geothermal Investigations.—Wairakei geothermal project.

Sulphur.—Sulphides as a source of sulphur, Thames district.

Pozzolanas and Reactive Aggregates.—Investigation of pozzolanas (Waikato and Foulden Hills) and reactive concrete aggregate (Waikato) in relation to dam construction.

Fertilizers.—Dunite and serpentinite for fertilizer manufacture, fusion process.

Railways and Highways.—Investigations on stability of country for Railways Department and Ministry of Works.

Cretaceous Stratigraphy.—Revision in relation to oil source, and reservoir rocks.

Rutile.—Orepuki sands as a possible source of rutile.

Perlite.—Search for suitable rocks for perlite manufacture, Rotorua-Taupo and Banks Peninsula.

PUBLICATIONS

Problem of the Anomalous Lower Course of the Waianakarua River, North-east Otago. *Trans. Roy. Soc. N.Z. 81*:345–8. G. L. Adkin.

Geological Evidence of the Antiquity of Man in the New Zealand Area (abstract). *Roy. Soc. N.Z. 7th Sci. Congr.*:123–4. G. L. Adkin.

Ground Water in the Hydrologic Cycle, With Special Reference to Canterbury, New Zealand. *Ibid.*:127–39. B. W. Collins.

Long-term Records of Ground-water Levels in Canterbury (abstract). *Proc. 7th Pacif. Sci. Congr., 2*:129. B. W. Collins.

Discovery of Pliocene Marine Fossils in South Canterbury (abstract). *Proc. 7th Pacif. Sci. Congr., 2*:130. B. W. Collins.

Thermal Waters of Banks Peninsula, Canterbury, Christchurch. *Proc. 7th Pacif. Sci. Congr. 2*:469–81. B. W. Collins.

Plant Microfossil Dating of Some New Zealand Upper Tertiary Volcanic Rocks. *N.Z. J. Sci. Tech. B34*:373–7. R. A. Couper.

Distribution of Proteaceae, Fagaceae, and Podocarpaceae in Some Southern Hemisphere Cretaceous and Tertiary Beds. *Ibid. B35*: 247–50. R. A. Couper.

Correlation by Plant Fossils. *N.Z. Sci. Rev. 11*:138–9. R. A. Couper.

Upper Mesozoic and Cainozoic Spores and Pollen Grains from New Zealand. *N.Z. Geol. Surv. Pal. Bull. 22*. 77 pp. R. A. Couper.

The Geology of the Wanganui Subdivision. *N.Z. Geol. Surv. Bull. n.s. 52*. 361 pp. C. A. Fleming.

Materials for a Recent Geochronology of New Zealand. *Roy. Soc. N.Z., 7th Sci. Congr.*:114–23. C. A. Fleming.

New Evidence for World Correlation of Marine Pliocene. *Aust. J. Sci. 15*:135–6. C. A. Fleming.

Faunal Immigration to New Zealand. II. Immigration of Gastropods and Pelecypods to New Zealand During the Tertiary. *N.Z. J. Sci. Tech. B34*:444–8. C. A. Fleming.

Lower Jurassic Fossils from Taneatua, Bay of Plenty, New Zealand. *Ibid. B35*:129–33. C. A. Fleming.

A Triassic Oyster from New Zealand. *Ibid. B35*:276–8. C. A. Fleming.

Collections of Mollusca in the New Zealand Geological Survey. *Conch. Sect. Auck. Mus., Bull. 9*:6–8. C. A. Fleming.

Some Particular Aspects of Correlation: Facies, Shifting Climates and Zones. *N.Z. Sci. Rev. 11*:137–8. C. A. Fleming.

The Geology of the Snares Islands. Part I: General Geology; Part II: Petrology; Part III: Peat Samples. *Cape Exped. Ser., Bull. 13*. 42 pp. C. A. Fleming, J. J. Reed, and W. F. Harris.

Preliminary Account of Hydrothermal Conditions at Wairakei, New Zealand (abstract). *8th Pacif. Sci. Congr.*:11. J. Healy.

Activity at Ngauruhoe, New Zealand, November, 1952, to July, 1953. *(Hawaii) Volc. Lett. 521*:7–8. J. Healy.

Some New Zealand Marine Ostracoda Useful in Stratigraphy. *Trans. Roy. Soc. N.Z. 81*:303–11. N. de B. Hornibrook.

Jurassic Foraminifera from New Zealand. *Ibid.*:375–8. N. de B. Hornibrook.

Marine Ostracoda in Post-Jurassic Stratigraphy in New Zealand. *Roy. Soc. N.Z., 7th Sci. Congr.*:142. N. de B. Hornibrook.

Faunal Immigrations to New Zealand. I.—Immigration of Foraminifera to New Zealand in the Upper Cretaceous and Tertiary. *N.Z. J. Sci. Tech. B34*:436–44. N. de B. Hornibrook.

General Aspects of Correlations by Marine Fossils. *N.Z. Sci. Rev. 11*:134–7. N. de B. Hornibrook.

Physical Measurements in Water Surveys. *Roy. Soc. N.Z., 7th Sci. Congr.*:127. I. C. McKellar.

A Fossil Flora from the Upper Pliocene of Rangitikei Valley. *N.Z. J. Sci. Tech. B35*:134–40. D. R. McQueen.

Divisions and Faunas of the Hokonui System (Triassic and Jurassic). *N.Z. Geol. Surv. Pal. Bull. 21*. 141 pp. J. Marwick.

Faunal Migrations in New Zealand During the Triassic and Jurassic. *N.Z. J. Sci. Tech. B34*:317–21. J. Marwick.

A Pliocene Fossil Found Living by the *Galathea* Expedition. *Ibid. B35*:109–12. J. Marwick.

Hydrothermal Rock Alteration at Wairakei, New Zealand. *Econ. Geol. 48 (1)*:1–13. A. Steiner.

The Genus *Pelicaria* in the Tertiary of East Wairarapa. *Trans. Roy. Soc. N.Z. 81*:35–48. P. Vella.

Data for the Study of Recent and Late Pleistocene Faulting in the South Island of New Zealand. *N.Z. J. Sci. Tech. B34*:270–88. H. W. Wellman.

Note on Maitai and Te Anau Rocks in Matakitaki Valley, Nelson (S32). *N.Z. J. Sci. Tech. B35 (1)*:36–7. H. W. Wellman.

GEOPHYSICS DIVISION

Superintendent: Dr E. I. Robertson

PROJECTS

Apia Observatory.—Continuous recording and analysis of earthquake data; continuous recording and analysis of the geomagnetic field; and investigation of cosmic ray vertical intensity.

Magnetic Survey.—Installation of modern magnetic instruments at Apia and Amberley; study of secular variation in the South-west Pacific area; continuous recording and analysis of the geomagnetic field at Amberley; and design of fluxgate magnetometers for research purposes.

Geophysical Observatory.—Continuous recording and analysis of ionospheric conditions at Christchurch, Rarotonga, and Campbell Island; the determination of electron distribution with height; recombination and attachment processes in the F2 layer; occurrence of sporadic E at Christchurch; continuous recording of cosmic ray intensity at Christchurch; investigation of asymmetry in the cosmic ray intensity at Christchurch; and lunar variation.

Seismological Observatory.—Continuous recording and analysis of earthquake data; provision of New Zealand time service; crustal structure of the New Zealand region; study of the seismicity at Tongariro National Park; and geological significance of seismic activity.

Oceanographic Observatory.—Hydrology of the South-west Pacific Ocean; hydrology of the New Zealand coastal region; ocean current investigations in the South-west Pacific and New Zealand coastal waters; tidal circulation, wave characteristics, and sedimentation in Lyttelton and Wellington harbours; study of the morphology, structure, and sedimentation of Cook Strait and the New Zealand Continental shelf; marine fouling in New Zealand harbours; and determination of the direction of travel of ocean waves.

Geophysical Survey.—Hydro-electric dam site investigations; structure of the Rotorua-Taupo thermal area; fundamental studies of volcanic phenomena; the geological structure of the principal oil areas of New Zealand; gravity investigations of the geological structure of the South Island; magnetic and elastic properties of rocks; convergence measurements in coal mines; and scintillometer surveys.

Underwater Research Laboratory.—Research projects for the Royal New Zealand Navy.

PUBLICATIONS

Note on D-region Echoes at Christchurch. *N.Z. J. Sci. Tech. B35*:38. J. W. Beagley.

Ionospheric and Geomagnetic Effects of Solar Flares. *Ibid. B35*:141–51. J. W. Beagley.

Ionospheric Research. *The Antarctic Today,* Chap. 13. J. W. Beagley.

An Improved Electro-mechanical Seismic Source Tested in Shattered Rock. *N.Z. J. Sci. Tech. B35*:4–13. F. F. Evison.

Physical Characteristics of Inshore Waters Between Cook Strait and Banks Peninsula, New Zealand. *Ibid. B35*:239–46. D. M. Garner.

Note on a Proposed Three-component Aeromagnetometer. *Ibid. B35*:1–3. V. B. Gerard.

Aeromagnetic Observations Over the Banks Peninsula Area and the Mernoo Bank. *Ibid. B35*:152–9. V. B. Gerard.

The Magnetic Properties of the Whakamaru Ignimbrites. *Ibid. B35*:421–32. T. Hatherton.

A Note on the Geology of Cape Palliser, New Zealand. *Ibid. B35*:440–50. H. W. Wellman and J. W. Brodie.

GRASSLANDS DIVISION

Director: Dr J. Melville

PROJECTS

Pasture Establishment.—Grass seeding rates and effect of artificial nitrogen; oversowing of grasses and clovers in established pastures; effect of cover crop in establishment; pre- and post-emergence use of hormone weedkillers for establishing pastures; nutrient requirements of seedling clovers before and after nodulation; and pasture establishment on pumice soils.

Pasture Management.—Comparison of farming systems for fat lamb production; a study of the factors involved in maximum butterfat per acre production (in collaboration with Massey Agricultural College); comparison of five grass species in simple mixtures with white clover under sheep grazing; management of new pastures sown down with widely varying seeds mixtures; grazing intensity and survival of short-rotation ryegrass in the autumn; rotational grazing versus set stocking of short rotation and perennial ryegrass pastures for fat lamb production; fertilizer trials—effect of phosphorus, sulphur, lime, and molybdenum on pasture growth; and interaction of water and nitrogen on pasture growth in summer.

Pasture Improvement on Hill Country.—Pre- and post-sowing management for establishment of oversown clovers and *Lotus;* methods for thickening up sparse clover stands; rotational grazing versus set stocking of hill country pastures and the provision of winter and summer feed; studies on the differential management of sunny and shady slopes; studies in reseeding of subterranean clover under different managements; and buried clover seed in hill country soils and its ecological implications.

Plant Physiology.—Influence of environment and of defoliation on the growth patterns of major pasture species; the influence of different temperature levels on the growth of pasture species under controlled environments; phosphate uptake by intact and excised roots of grasses and wheat; the effect of the "apparent free space" in roots and its significance in transport of nutrients; and the terminal oxidase system in roots.

Plant Chemistry.—Bloat; the soluble constituents of pasture herbage—patterns of synthesis under different environmental conditions and their effect on ruminant metabolism; and the cytoplasmic proteins of pasture species.

Plant Breeding and Genetics.—The maintenance and improvement of bred strains of pasture plants; the selection and breeding of strains of *Lotus* and *Zigzag* clover; the breeding of a new ryegrass with characters midway between perennial and short-rotation; the production and study of polyploids in red clover; hybridization of *Lolium* and *Festuca* to determine whether the desirable features of each genus can be combined in one plant; the production of a white clover strain which breeds true for an easily identifiable leafmarking; the production genetics of ryegrasses; determination of the optimum number of basic plants for a bred strain of perennial ryegrass; seed production studies in cocksfoot and timothy; and reaction of strains of red clover to photoperiod with the aim of improving certification procedures.

Miscellaneous.—Earthworm populations under pasture at monthly intervals; establishment of artificial colonies of long-tongued bumble bees to improve pollination of red clover; lysimetry trials; and anatomy of ryegrass and paspalum.

PUBLICATIONS

Pasture Growth and Soil Fertility. *N.Z. J. Sci. Tech. A35.* P. D. Sears. Part I. The Influence of Red and White Clovers, Superphosphate, Lime, and Sheep Grazing on Pasture Yields and Botanical Composition. *Supp. 1*:1–29.

Part II. The Influence of Red and White Clovers, Superphosphate, Lime, and Dung and Urine on the Chemical Composition of Pasture. *Supp. 1*:30–41.

Part III. The Influence of Red and White Clovers, Superphosphate, Lime, and Dung and Urine on Soil Composition, and on Earthworm and Grass Grub Populations. *Supp. 1*:42–52.

Part IV. The Influence on Soil Fertility of Clovers, Superphosphate, Lime, Dung and Urine Applied to the Pastures, as Measured by the Growth of Subsequent Forage Crops. *Supp. 1*:53–67.

Part V. The Effects of Nitrogenous Fertilizers and of "Day" and "Night" Grazing. *Supp. 1*:68–77.

Part VI. Influence of Red and White Clovers, Superphosphate, Lime, and Sheep Grazing on Pasture Yields and Composition on the Growth of Subsequent Forage Crops; Results at Gore and Lincoln. pp. 199–220.

Part VII. General Discussion of the Experimental Results, and of Their Application to Farming Practice in New Zealand. pp. 221–55.

Note on the Setting Up of a Battery of Small Lysimeters. *J. Sci. Tech. A35*:394. C. A. Smith.

The Fermentation of Glycerol in the Rumen of Sheep. *Ibid. A35*:262–9. A. T. Johns.

The Effect of Soil Acidity on the Growth of Pasture Plants. I. Pot Experiments With Grasses and Clovers in Acidified Soils. *Ibid. A35*:311–26.

Influence of Light and Temperature on the Growth of Ryegrass. *Physiologia Plantarum 6*. K. J. Mitchell.

Part I. Pattern of Vegetative Development. pp. 21–46.

Part II. The Control of Lateral Bud Development. pp. 425–43.

Ion Uptake by Young Wheat Plants. *Physiological Plantarum 6*. G. W. Butler.

Part I. Time Course of the Absorption of Potassium and Chloride Ions. pp. 594–616.

Part II. The "Apparent Free Space" of Wheat Roots. pp. 617–35.

Part III. Phosphate Absorption by Excised Roots. pp. 637–61.

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The Free Amino-acids and Peptides of Plant Tissues. *J. Sci. Food & Agri. 4*:221–226. N. O. Bathurst.

Breeding for Resistance to "Blind Seed" Disease in the Ryegrasses (*Lolium* spp.). *Proc. 6th Int. Grassl. Congr. II*:1578–84. L. Corkill.

Experimental Work on Cocksfoot Seed Production. *Proc. 14th Conf. N.Z. Grassl. Ass.*, pp. 74–84. J. P. Lambert and W. G. Thurston.

The Storage of Pasture Seeds. *Ibid.*, pp. 221–7. E. O. C. Hyde.

Seeding Rates of Short-rotation Ryegrass. *Ibid.*, pp. 172–81. R. W. Brougham.

Growth Habits of Short-rotation and Perennial Ryegrass. *Ibid.*, pp. 164–71. K. J. Mitchell.

Pasture Establishment. *Proc. 13th Conf. N.Z. Soc. Animal Production*, pp. 82–7. P. D. Sears.

Ruminant Metabolism. *Ibid.*, pp. 106–11. A. T. Johns.

Pasture Quality and Animal Production. *Ibid.*, pp. 65–73. J. Melville.

The Pattern of Growth of Individual Pasture Plants. *Ibid.*, pp. 74–81. K. J. Mitchell.

Pasture Management for Bloat Control. *Proc. 6th Ann. Mtg. Dairy-farmers, Massey Agric. Coll.*, pp. 113–8. P. D. Sears.

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Results of Experiments on the Improvement of Hill Country Pastures at Te Awa Hill Country Experimental Station. *Proc. 16th Ann. Mtg. Sheepfarmers, Massey Agric. Coll.*, pp. 69–90. F. E. T. Suckling.

Some Impressions of Grassland Farming in Europe. *Ibid.*, pp. 113–24. L. Corkill.

Nutrient Uptake of Turf Grasses and Fertilizer Effects. *Proc. 17th Ann. Conf. N.Z. Greenkeepers Ass.*, pp. 21–9. D. B. Edmond.

The Spraying of Bare Soil With 2,4-D to Control Turf Weed Seeds. *Ibid.*, pp. 51–60. S. T. Coles.

Weeds in Bowling Greens. *Proc. Conf. Bowling Greenkeepers* (1953), pp. 20–4. D. B. Edmond.

HOP RESEARCH

Station Research Officer: Dr R. H. J. Roborgh

PROJECTS

Breeding.—The study of botanical characters to aid differentiation of hop varieties; the introduction and evaluation of hop varieties from overseas; the breeding of new hop varieties resistant to root rot (*Phythophthora* spec.)—the germination of hop seed, the technique of testing for susceptibility to root rot at the seedling stage, and the technique of rapid propagation of promising seedlings; and the raising of polyploids.

Agricultural Operations.—Wiring the garden at different heights; spacing of hop hills; cultivation and covercropping on the different soil types; manuring, particularly as regards influence on the occurrence of root rot; pruning at different times throughout the year; the evaluation of different stringing methods; training different types of vines; picking by hand with and without cutting the vines; and drying conditions.

INFORMATION BUREAU

Officer in Charge: Mr N. A. Marris

PROJECTS

The Information Bureau exists primarily to give specialized services to branches of the department and others. Although it does not undertake scientific research, a number of investigations of interest to corresponding organizations are under way. These include work on standards for editing scientific papers; the application of stereophotography to scientific research; and examination of photo-copying methods with the object of reducing expenditure and saving time.

PUBLICATIONS

On behalf of other branches of the Department, the Information Bureau has edited and published some 20 bulletins, memoirs, and reports during the year. These are set out in the separate lists of publications of the individual branches. Publications edited by the Information Bureau and issued by the department as a whole include the following:

Annual Report.
"Departmental Handbook".
Dominion Laboratory booklet.
Cape Expedition Series Bulletin:

12. Land Planarians from Auckland and Campbell Islands. Marion L. Fyfe.
13. The Geology of the Snares Islands. C. A. Fleming, J. J. Reed, and W. F. Harris.
14. The Ticks (Ixodoidea) of the New Zealand Sub-region. L. J. Dumbleton.

Linen Flax Fibre Production in New Zealand. J. W. Hadfield. A joint publication by the Linen Flax Corporation of New Zealand and the Departments of Agriculture, Industries and Commerce, and Scientific and Industrial Research.

PLANT DISEASES DIVISION

Director: Dr G. H. CUNNINGHAM

PROJECTS

Entomology

Carrot Rust Fly.—Life history studies; and ecological studies on population.

Chrysanthemum Gall Midge.—Life history studies; studies on therapeutant control; determination of incidence; and studies on varietal resistance.

Aphids.—Studies on swede varietal resistance to aphids; and studies of population growth models and comparison of rate of reproduction of North versus South Island strains of mealy cabbage aphid.

Citrus Thrips.—Life history studies.

Oak Leaf Miner.—Incidence studies.

Insecticide Studies.—Laboratory tests to determine compatibility of therapeutants in mixtures; and studies on toxicity of residual deposits of insecticides.

New Insects.—Citrus bud mite and white fringed moth; and incidence studies.

Taxonomic.—Studies on *Acarina, Lepidoptera,* and *Diptera;* stored products pests (moths and spider beetles); and leaf rolling insects.

Economic Mycology

Rust of Linen Flax and Linseed.—Maintenance of flax rust race collection; search for new flax rust races in New Zealand; and studies on control of alternative hosts of flax rust.

Dry Rot of Swedes.—Studies on resistance and selection of resistant material for breeding.

Cereal Diseases.—Wheat: powdery mildew race survey; leaf blotch—effect on yield, varietal resistance studies; root and crown diseases—incidence studies; and virus diseases—incidence studies.

Oats: Leaf and stem rust—incidence and varietal resistance studies; root diseases; and covered smut—control by seed treatment.

Potato Diseases.—Late blight—isolation of races for resistance breeding studies; and pink rot—studies on incidence and control.

Pea Diseases.—Pea wilt—testing for varietal resistance; and seed-borne diseases—control by seed treatment.

Blind Seed of Ryegrass.—Studies on biology of infection.

Onion White Rot.—Control by soil disinfection; and testing of selected bulbs for resistance.

Cypress Canker.—Taxonomic studies of causal fungus; and varietal resistance studies.

Tomato Diseases.—*Botrytis* rot—control of infection induced by hormone fruit setting sprays; and *Phytophthora* foot rot—control by soil treatment.

Fruit Tree Diseases.—Apple collar rot—studies on varietal resistance in rootstocks; silver leaf—studies on recovery of infected trees, control by systemic fungicides; and Pythium disease of pear—studies on incidence, pathogenicity, and economic importance.

Bean Rust.—Control by spraying; and testing of breeding material for resistance work.

Verticillium Wilt.—Host range studies.

Chrysanthemum Diseases and Pests.—Studies on rust, septoria spot, and eelworm, and their interaction.

Turf Diseases (Fungi, Moss, and Algae).—Therapeutant control studies.

Industrial Mycology.—Control of moulds on cork, leather, and composition materials.

Heat Treatment for Control of Seed-borne Diseases.—Studies on use of hot carbon tetrachloride on control of seed-borne diseases.

New Diseases.—Identification and recording of new fungous diseases and additional host plants.

Systematic Mycology

Herbarium.—Collection and identification of New Zealand fungi.

Preparation of Monographs of Genera of Thelephoraceae.—Cyphelloideae (genera *Cyphella* and *Solenia*) and *Pellicularia.*

Taxonomic.—Studies of the *Actinomycetales;* revision of the *Hypocreales* of New Zealand; culture and life history studies of New Zealand species of *Nectria, Hypocrea,* and *Gibberella;* and description and listing of *Cystopus* species present in New Zealand.

Bacteriology and Microbiology

Blast of Stone Fruit.—Studies on systematics of the causal organism; determination of host range; factors affecting infection; studies on control by therapeutants, including antibiotics; *in vitro* studies of the effect of antibiotics on the causal organism; and investigations on systemic control with streptomycin.

Halo Blight of Bean.—Studies on therapeutant control.

Bacterial Blight of Pea.—Studies on varietal resistance; and studies on control by therapeutants.

Crown Gall.—Methods of preventing infection; and methods of controlling infection.

Potato "Sun Scald".—Investigations into cause.

Legume Nodule Bacteria.—Clovers: determination of effectiveness of different strains in glasshouse and field; studies on effect of such factors as soil and climate on efficiency of different strains; and investigation into possibility of selecting a strain efficient on red, white, and subterranean clover in all localities in New Zealand.

Lucerne: supply of cultures to treat all lucerne seed sown in New Zealand; and investigation of the possibility of strain differences in the lucerne nodule bacteria occurring on lucerne in New Zealand.

Antibiotics.—Absorption and translocation studies with antibiotics in peach seedlings.

Virus Diseases

Legume Viruses.—Studies on incidence of legume viruses in pastures in Manawatu and Hawke's Bay; and testing breeding material of garden peas for resistance to pea mosaic.

Brassica Viruses.—Studies on incidence in swede seed mother plants (for Department of Agriculture).

Lettuce Big Vein.—Studies on control.

Grey Wall and Blotchy Ripening of Tomato.—Studies on cause of these conditions.

Chrysanthemum Viruses.—Studies on identification of two viruses attacking chrysanthemums.

Miscellaneous Studies.—Methods of increasing stability of unstable viruses in extracted sap; study of factors affecting susceptibility of plants to virus infection; and statistical analysis of virus infectivity measurements.

Yellow-leaf of Phormium.—Seed transmission studies, and host range studies.

Fruit Tree Virus Diseases (in collaboration with the Fruit Research Station).—Apple mosaic: effect on tree growth and fruit yield; studies on strains present in New Zealand; and cross protection studies. Apple green crinkle: varietal range studies. Apple ring spot: transmission and varietal range studies. Pear stony pit: varietal range studies. Identification of stone fruit virus diseases. Plum mosaic: effect on tree growth and fruit yield; and effect of infection on scion-stock compatibility.

Plant Therapeutants

Therapeutant Certification.—This involves the issue of revised certification lists twice yearly.

Efficacy of Plant Therapeutants.—Glasshouse screening tests and field trials with spray materials using the following test organisms: late blight on tomato and potato, grey mould on tomato and lettuce, rust on dwarf and broad bean, black spot on apple, Fabraea scald on quince, leaf spot on celery, leaf mould on tomato, brown rot on peach, red mite on apple, codling moth on apple, and mite on bean.

Glasshouse and field trials with seed dusts using the following test organisms: head smut on maize, common scab on potato, and damping off on vegetables and flowers.

Glasshouse and field trials with soil disinfectants using the following test organisms: verticillum wilt on tomato, club root on brassicas.

Therapeutant Control of Particular Diseases.—Pests and diseases of roses; pests and diseases of grape vines; corm diseases of Gladiolus; and storage diseases of potato.

Phytotoxicity of Plant Therapeutants.—Mercury damage to apple buds; effects of insecticides and fungicides on seed germination; and effect of BHC on stored seed.

Spray Treatments.—Toxic residues on fruit and vegetables following spray treatments (carried out in collaboration with Dominion Laboratory); and compatibility of therapeutants used in spray mixtures.

Plant Quarantine.—The growing under quarantine of plants which are prohibited from entering New Zealand under the Plant Quarantine Regulations.

Horticulture

Silver Leaf on Peach.—Studies on effect of summer and winter pruning on incidence.

Budding.—Study of factors causing variation in bud union.

Chrysanthemum Eelworm.—Effect of modifications of hot water treatment on efficacy of control.

Soil Conditioners.—Studies on effectiveness of soil conditioners in improving plant growth.

Roses.—Investigation of therapeutant control of black spot; and studies on effect of planting methods on death of bushes.

Timber Preservation

Toxicity of Preservatives.—Testing toxicity of wood preservatives against common house borer; determination of minimum toxic loading of wood preservatives required to prevent infestation with common house borer; and testing of materials for control of existing infestations of common house borer.

Pinus.—Studies on susceptibility of *Pinus radiata* timber to common house borer (in collaboration with Division of Forest Products, C.S.I.R.O., Melbourne).

Application of Preservatives.—Studies on the correlation between theoretical and actual values of diffusion of chemicals into green wood; and introduction into commercial practice of momentary immersion method of preserving timber with boron compounds.

Leaching.—Studies on leaching of water-soluble wood-preservatives from painted weatherboards.

PUBLICATIONS

First Supplement to "A Revised List of Plant Diseases Recorded in N.Z., 1949–51". *N.Z. J. Sci. Tech. A34*:556–61. R. M. Brien and Joan M. Dingley.

Experiments in Control of Peach Brown Rot. *Ibid. A35*:437–50. P. J. Brook.

Note on the Systemic Nature of Apple-mosaic Virus in Apple Trees. *Ibid. A34*:551–2. E. E. Chamberlain, J. D. Atkinson, and J. A. Hunter.

Certification of Therapeutants, 33rd List. Suppl. *Orchardist of N.Z. 26* (7) (Aug. 1953). G. H. Cunningham.

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Thelophoraceae of New Zealand. Part 1. Sub-family Cypelloideae. *Trans. Roy. Soc. N.Z. 81*:165–88. G. H. Cunningham.

Thelephoraceae of New Zealand. Part 2. The Genus Pellicularia. *Ibid. 87*:321–8. G. H. Cunningham.

Seed Disinfection. 7. Effect of Seed Treatments on Emergence of Linseed and Linen Flax. *N.Z. J. Sci. Tech. A35*:33–8. I. A. M. Cruickshank and H. Jacks.

Seed Disinfection. 9. Control of Onion Smut (*Urocystis cepulae*). *Ibid.*:390–3. I. A. M. Cruickshank and H. Jacks.

The Hypocreales of N.Z. (5. The Genera *Cordyceps* and *Torrubiella*). *Trans. Roy. Soc. N.Z. 81*:329–43. Joan M. Dingley.

Blast of Stone Fruit in New Zealand. *N.Z. J. Sci. Tech. A35*:451–61. D. W. Dye.

Control of *Pseudomonas syringae* With Streptomycin. *Nature 172*:683. D. W. Dye.

Differential Effect of Therapeutants on Bacterial Canker of Tomatoes and on Late Blight. *N.Z. J. Sci. Tech. A35*:462–4. D. W. Dye.

Notes on Diptera. *N.Z. Entomologist 1*:9–11. R. A. Harrison.

The Diptera of the Antipodes and the Bounty Islands. *Trans. Roy. Soc. N.Z. 81*:269–82. R. A. Harrison.

The Fly Spray Testing Method in N.Z. *N.Z. J. Sci. Tech. B34*:457–61. R. A. Harrison.

Transportation of Insects by Aircraft. *N.Z. Entomologist 1* (3):22. R. A. Harrison.

Toxicity of Pyrethrum to Houseflies. *N.Z. J. Sci. Tech. B35*:22–9. R. A. Harrison.

Toxicity to Houseflies of Paints Containing DDT. *Ibid.*:43–4. R. A. Harrison.

A Review of Experimental Work on Lead Arsenate Injury. *Orchardist of N.Z. 26* (3):7, 9. H. Jacks.

Compatibility of Spray Materials Used in New Zealand on Apples, 1953. *Ibid. 26* (5):31. H. Jacks.

Compatibility of Spray Materials Used in New Zealand on Potatoes, 1953. *Ibid. 26* (3):17. H. Jacks.

Compatibility of Spray Materials Used in New Zealand on Tomatoes, 1953. *Ibid.*:16. H. Jacks.

Disinfection of Vegetable Seeds. *N.Z. J. Agric. 87* (3):217–24. H. Jacks.

Disinfection of Nursery Soil. *N.Z. Dept. Agriculture Bulletin 363*. 12p. H. Jacks.

Orchard Spray Trials, 1952–53. Suppl. *Orchardist of N.Z. 26* (10). H. Jacks.

Plant Quarantine. 1. List of Plant Diseases and Pests Intercepted in New Zealand in 1951. *N.Z. J. Sci. Tech. A35*:169–71. H. Jacks.

Plant Quarantine. 2. List of Plant Diseases and Pests Intercepted in New Zealand in 1952. *Ibid.*:273–5. H. Jacks.

Plant Therapeutants Under Test for Certification. *Orchardist of N.Z. 26* (11): 27. H. Jacks.

Plant Therapy. *Proc. 1952–53 Conf. Inst. Park Administration.* H. Jacks.

Precautions With Organic Phosphorus Insecticides. *N.Z. J. Agric. 87*: 371–5. H. Jacks.

Seed Disinfection. 6. Surface Disinfection of Vegetable Seeds. *N.Z. J. Sci. Tech. A34*:492–5. H. Jacks.

Seed Disinfection. 8. Control of Weevil Damaging French Beans and Maize Seed in Storage. *Ibid. A35*:159–63 H. Jacks.

Soil Disinfection. 14. Effect of Chemical Soil Disinfectants on Control of Weeds. *Ibid. A34*:487–91. H. Jacks.

Vegetable Therapeutant Trials in 1951–52. Suppl. *Orchardist of N.Z. 26* (6). H. Jacks.

Control of Onion Smut. *Com. Gard. J. 9*:8. H. Jacks and I. A. M. Cruickshank.

Control of Onion Thrips. 2. Final Selection of Insecticides. *N.Z. J. Sci. Tech. A35*:164–8. H. Jacks and R. A. Harrison.

New Apparatus for High Pressure Steaming of Soil. *Com. Gard. J. 9*:4. H. Jacks and T. P. Lidgard.

Damage to Flower Seedlings and Plants by Application of HETP (TEPP) Insecticide. *N.Z. Gardener,* 1 May 1953. H. Jacks and H. W. Rosser.

A Revision of the Gall Mites (*Acarina Eriophyidae*) Occurring on Tomato (*Lycopersicum esculentum* Mill) With a Key to the Eriophyidae Recorded from Solanaceous Plants. *Bull. Ent. Res. 44*: 343–50. K. P. Lamb.

Field Trials of Five Swede Varieties. *N.Z. J. Sci. Tech. A35*:135–45. K. P. Lamb.

Observations on Yield and Varietal Susceptibility of Some Carrot Varieties to Insect Attack in the Field. *Ibid. A34*:531–7. K. P. Lamb.

Survey of Red Spider Mites (*Acarina: Tetranychidae*) on Grape Vines. *N.Z. J. Sci. Tech. A35*:65–6. K. P. Lamb.

Tomato Gall Mites From Morocco. *Bull. Ent. Res. 44*:401–4. K. P. Lamb.

Chemotherapy and Plant Viruses. *J. Gen. Microbiol. 8*:277–88. R. E. F. Matthews.

Factors Affecting the Production of Local Lesions by Plant Viruses. 1. The Effect of Time of Day of Inoculation. *Ann. Appl. Biol. 40*: 377–83. R. E. F. Matthews.

Factors Affecting the Production of Local Lesions by Plant Viruses. Part 2. Some Effects of Light, Darkness and Temperature. *Ibid.*: 556–65. R. E. F. Matthews.

Incorporation of 8-Azaguanine Into Nucleic Acid of Tobacco Mosaic Virus. *Nature 171*:1065–6. R. E. F. Matthews.

Combined Hormone-fungicide Sprays for Control of *Botrytis* Fruit-rot in Glasshouse Tomatoes. *Nature 172*:351. F. J. Newhook and R. M. Davison.

Collar Rot of Apple Trees in Essex. *Plant Pathology 2*:85–6 H. C. Smith.

A Common Moth in Auckland. *N.Z. Entomologist 1*:11–2. K. A. J. Wise.

Host Plants of *Lithocolletis messaniella*. *N.Z. J. Sci. Tech. A35*:172–4. K. A. J. Wise.

Leaf Mining Pests in New Zealand. *N.Z. J. Agric. 87*:75–6. K. A. J. Wise.

Occurrence of the Oak Blotch Miner (*Lithocolletis messaniella* Zeller) Lepidoptera Gracillariidae in N.Z. *Trans Roy. Soc. N.Z. 81*:65–6. K. A. J. Wise.

Experimental Observations on the Possibility of Transmission of Yaws by Wound Feeding Diptera in Western Samoa. *Trans. R. Soc. Trop. Med. Hyg. 47*:148–53. G. H. Satchell and R. A. Harrison.

Arsenic and Lead Residues on Apples. *N.Z. J. Sci. Tech. B35*:311–4. P. J. Clark and H. Jacks.

Mercury Residues on Tomatoes. *N.Z. J. Sci. Tech. B35*:301–6. H. M. Stone, P. J. Clark, and H. Jacks.

SCIENTIFIC LIAISON SERVICE

ACTIVITIES AND PROJECTS

London.—During the year the New Zealand Scientific Adviser, London, has been Chairman of the Executive Council of the Commonwealth Agricultural Bureaux, and has also attended meetings of the Commonwealth Advisory Committee on Defence Science and the Commonwealth Advisory Aeronautical Research Council. General activities have included the United Kingdom scientific administration of the New Zealand National Research Fellowships and Defence Science Corps, while special activities included work on dehydrated food products and the forwarding of radio-active isotopes (for medical, experimental and industrial purposes), to New Zealand.

Washington.—The work of the office has covered the obtaining and forwarding of technical information, special scientific publications, specimen materials, etc., to New Zealand. In addition, assistance has been given to scientific visitors from New Zealand, and information on New Zealand research work has been made available to interested organizations in the United States of America.

SOIL BUREAU

Director: Mr N. H. Taylor

PROJECTS

Agricultural

Soil Surveys.—North Island: Wairarapa Plains with detailed survey near Greytown (2 m./in.); Gisborne flats (20 ch./in.); Taupo district (40 ch./in.); sand country, Manawatu, Part 1 (40 ch./in.); and Paekakariki and Hutt sheets, Wellington (40 ch./in.).

South Island: plains and downlands of Canterbury and North Otago (2 m./in.); Inchclutha (40 ch./in.); Maniototo Basin (40 ch./in.); South Island (4 m./in.); fruit growing areas of Central Otago (40 ch./in); Geraldine County (40 ch./in.); Heathcote County (40 ch./in.); Crown Terrace, Lower Shotover, Nevis, Arrow River, in Central Otago; and Kowhai County (2 m./in.).

Fiji: The soils of Viti Levu (2 m./in.).

Special Investigations.—Survey of inorganic soil colloids in New Zealand soils; effect of heat upon cation exchange capacity of mineral colloids; base exchange mechanism of allophane clays; survey of available minerals in soils as extracted by sweet vernal; the potassium supplying power of soils; forms of phosphorus in New Plymouth black loam—comparison of soils from heavily and lightly topdressed farms, and residual effects of topdressing; forms of phosphate in Haast-Alexandra soils; composition of soil solutions of main soil types; earthworm survey of New Zealand soils; biological survey of tussock grassland soils; ecology of Takahe Valley (part); pF curves of Taupo pumice soils; soil frost investigations at Molesworth; specific gravities of clay soils; and physical examination of the soils of the Takapau series.

Forestry

Kaingaroa Forest soils; chemical investigation of the litter and humus of red beech; rate of podzolization on pumice soils under *Pinus radiata;* soil fertility problems in the Golden Downs State Forest; moisture status of forest and cleared land, Westland; and relation of exotic pine growth to soils in North Auckland and in Tairua.

Engineering

Physical properties of New Zealand estuarine soils; a compilation of basic soil mechanics data from test sites; subsoil survey of part of the Porirua Basin development area; and correlation of the corrosion of buried test plates or pipes with chemical data—steel, cement, asbestos, and concrete.

PUBLICATIONS

Phosphate-uptake Studies With Radioactive Phosphorus. *N.Z. J. Sci. Tech. A34*:496–506 K. Strzemienski.

A Note on the Earthworm Fauna of the Kermadec Islands. *Trans. Roy. Soc. N.Z. 81*:49–51. K. E. Lee.

Some Physical Properties of New Zealand Loess. *N.Z. J. Sci. Tech. B35*:30–5. K. S. Birrell and R. Q. Packard.

Features of Growth of Actinomyces in Soil. *Research 6*:6. R. H. Thornton.

The Chloride Content of Rainwater Collected in the Wellington Province. *N.Z. J. Sci. Tech. B35*:193–7. L. C. Blakemore.

The Ecological Significance of the Central North Island Ash Showers. *Rep. 2nd Ann. Mtg. N.Z. Ecol. Soc.* 1953.
Paper 1. The Soil Pattern. N. H. Taylor.
Paper 2. The Distribution of Animals. K. E. Lee.

Revision of the Miocene and Pliocene Sediments of the Maniototo Basin. *N.Z. J. Sci. Tech. B35*:251–3. J. D. Raeside.

The Effects of Sheep Dung and Urine on a Soil Under Pasture at Lincoln, Canterbury, With Particular Reference to Potassium and Nitrogen Equilibria. *Ibid. A35*:327–59. A J. Metson and Frances B. Hurst.

A Note on the Regeneration of Tussock-grassland. *N.Z. Sci. Rev. 11*:154–5. J. D. Raeside.

Grassgrub Population in Soils of the Manawatu Sand Country. *N.Z. J. Sci. Tech. A35*:465–70. R. A. Cumber and J. D. Cowie.

Some Practical Applications of Clay Mineralogy. *J. N.Z. Chem. Soc. 18*:1–15. J. K. Dixon.

Rapid Method for Analysis of Soil Clays and Other Silicates. *N.Z. J. Sci. Tech. B35*:433–9. M. Fieldes, L. D. Swindale, J. P. Richardson, and I. C. McDowall.

Soils of the Lower Cook Group. *Soil Bureau Bulletin No. 8.* L. I. Grange and J. P. Fox (with soil analyses by F. T. Seelye, R. H. Arbuckle, and A. Valk).

Soils and Agriculture of Awatere, Kaikoura, and Part Marlborough Counties. *Ibid. No. 9.* H. S. Gibbs and J. P. Beggs (with chemical analyses by Alison D. Gibbons and Moyra R. Nolan).

General Survey of the Soils of the North Island of New Zealand. *Ibid. No. 5.* Staff of the Soil Bureau, D.S.I.R., and Extension Division, Department of Agriculture.

TOBACCO RESEARCH

Station Director: Mr R. Thomson

PROJECTS

Seedling Bed Work

An alternative to steam sterilization for the control of weeds and disease. Seed treatments for the control of disease. The incorporation of fungicides and insecticides in the soil prior to sowing. Use of soil conditioners.

The Crop in the Field

Fertilizers.—Optimum use of phosphate and potash, with and without magnesium, response of tobacco to minor elements—copper, zinc, manganese, and molybdenum; application of fertilizers—most suitable time to apply nitrogen; effect of boron on the yield and quality of Virginia Gold; and demonstration plots to illustrate various deficiencies.

Cultural.—Effect of spacing on size of leaf and total yield; rotation and cover crops—spelling the land for one season with a variety of cover crops; and control of laterals by chemicals.

Plant Breeding.—For resistance to black root-rot, mosaic, verticillium wilt, and phytophthora canker; and breeding for improved quality.

Variety Trials—Including locally developed lines and imported varieties from the United States of America and Rhodesia.

Seed Production.—Maintaining a supply of seed for the industry, plus a reserve.

Kilns and Curing.—Fundamental work on curing in cabinets under controlled conditions; and kiln design (in co-operation with Dominion Laboratory).

Insect Pests.—Control of wireworms by the use of soil insecticides.

PUBLICATION

Use of Methyl Bromide for the Control of Weeds in Tobacco Seedling Beds. *N.Z. J. Sci. Tech. A35*:146–51. R. Thomson and A. G. McLeod.

WHEAT RESEARCH INSTITUTE

Director: Mr E. W. Hullett

PROJECTS

Services.—Determination of the milling and baking quality of new wheats produced at the Crop Research Division; testing service for millers and bakers and the Wheat Committee; advisory service for farmers, millers, bakers, and other flour users (this includes bulk handling, storage, and drying of wheat, and many aspects of milling and baking technology, and involves visits by members of the staff to many mills and bakeries); and training courses in baking for apprentices (in co-operation with the Education Department and the Commissioner of Apprenticeship).

Other Projects.—Determination of requirements for the manufacture in New Zealand of special cake flours; the effect of baking tin dimensions on bread quality; and improvement of the Institute's facilities for experimental baking.

The baking quality of milk powder, with particular regard to export markets; systematic practical examination of breadmaking processes and the preparation of printed articles and lantern slides for courses of instruction; and biochemical study of oxidation in doughs; miscellaneous projects that can be carried on only when particular seasonal or other conditions arise include heating in bulk wheat, grain drying, and several flour quality problems.

PUBLICATIONS

Quality of This Season's Flour. *N.Z. Baker & Confectioner* (May 1953).

Bread Yields. *Ibid.* (July 1953).

Advice of Flour Characteristics. *Ibid.* (Aug. 1953).

When is a Dough Ready? *Ibid.* (Sept. 1953).

Linking Loaf Characteristics With Dough Maturity. *Ibid.* (Oct. 1953).

Calculation of Liquor Temperatures. *Ibid.* (Jan. 1954).

Tin Proof and Dough Maturity. *Ibid.* (Feb. 1954).

New Zealand Wheat Review, 1950–51–52 (with the Crop Research Division).

INCORPORATED RESEARCH ASSOCIATIONS

THE DAIRY RESEARCH INSTITUTE (N.Z.)

Director: Professor W. Ridder

The financial year of the Institute ends on 31 July next, when a separate report will be issued. The projects are those planned for the year ending 31 July 1954, and the publications for the year ending 31 July 1953.

PROJECTS

Trials are to be made in several commercial butter factories of one of the systems that have been found to be experimentally successful for the removal of off-flavours from cream by steam treatment.

The investigations on the tainting of milk, cream, and butter from insecticide treatment of pasture—carried out in co-operation with the Entomological Research Station of the D.S.I.R.—is to be continued with the examination of the butter by the Dominion Laboratory.

Unusual phage infection in a commercial cheese factory, found to be caused by waste discharges from another cheese factory into the river that provides the source of water supply, is to be investigated further. Investigations on cheese ripening, and on the allied problem of discoloration in cheese, are to be further developed. The attempt to isolate and identify the cheddar-flavour constituents is to be continued, and further studies are to be made on the experimental manufacture of Gruyere and cottage cheese.

In the engineering section further research is to be carried out on milk and cream surface coolers, on shrinkage losses in the curing of cheese, and on steam and coal utilization.

Milk production of the dairy cow in its many aspects, including the uniformity trials with identical twins, will continue to be studied.

PUBLICATIONS

The Properties of New Zealand Butters and Butterfats: III. Seasonal Variations in the Nature of the Unsaturated Acids of Butterfat as Estimated by Spectrophotometric Methods. *J. Dairy Res. 20*:101. A. K. R. McDowell.

The Stability of Some Bacterial Enzymes Toward Heat and Chemical Bactericides. *J. Gen. Microbiol. 7*:329. W. H. Oliver.

The Effect of Carbon Dioxide Pressure on a Bacterial Decarboxylase System. *Ibid. 8*:38. W. H. Oliver.

The So-called "Nascent" Bacteriophage Phenomenon. *J. Dairy Res. 20*:60. H. R. Whitehead, Anne East, and Lola McIntosh.

The Vitamin A Potency of New Zealand Butter. *Ibid. 20*:76. A. K. R. McDowell and F. H. McDowall.

The Principles of Milk-drying Equipment. *N.Z. Engineering 7*:325. J. K. Scott.

The Vacreator Used as a Continuous Concentrator. *Aust J. Dairy Tech. 7*:87. J. K. Scott.

The Effect of Different Cream Treatments During the Pasteurization Process on the Size Distribution of Fat Globules in Cream and Butter. *J. Dairy Res. 20*:201. R. B. Dolby.

A Photoelectric Method for Determination of Fat Aldehyde Values. *Ibid. 20*:198. R. M. Dolby.

The Bacteriophage Problem in Cheese Manufacture. *Bact. Res. 17*:109. H. R. Whitehead.

The Selection of Efficient Farm Milk Coolers. *Aust. J. Dairy Tech. 8*:12. J. K. Scott.

Cheddar-cheese Flavour and Its Relation to Tyramine Production by Lactic Acid Bacteria. *J. Dairy Res. 20*:217. J. C. Dacre.

THE NEW ZEALAND FERTILISER MANUFACTURERS' RESEARCH ASSOCIATION (INC.)

Director: Dr B. W. Doak

PROJECTS

Long term trial with various phosphatic fertilizers to determine the effect of continued applications of the same fertilizer on soil composition as well as on pasture yield.

Trial to determine the fineness of grinding necessary for efficient responses with fused calcium magnesium phosphates when used as pasture topdressing.

Trial to measure the effect of various superphosphate granule sizes when used as topdressing.

The role of calcium sulphate in the fertilizing value of super, including the effect of sulphate ion on phosphate availability, rate of loss of sulphate from soil, etc.

The use of fused products, containing trace elements (cobalt and molybdenum), as a means of reducing fixation in the soil.

Study of methods of phosphate determination.

THE NEW ZEALAND LEATHER AND SHOE RESEARCH ASSOCIATION (INC.)

Director: Mr F. W. Woodroffe

PROJECTS

Sodium hydrosulphide in place of sodium sulphide in fellmongers' paints.

Pickled pelt deterioration and the use of low free acid and fungicides.

Deterioration of calf skins in storage.

The use of phosphates as masking agents and as pretannages.

The substitution of glyoxal for formaldehyde in the fixing of finishes and as a tanning agent.

Hot pitting of sole leather: the effect of undissociated organic acids on the fixation of tans.

The behaviour of chamois leathers when stored wet, and the development of a method of measuring the degree of tannage of such leathers.

THE NEW ZEALAND POTTERY AND CERAMICS RESEARCH ASSOCIATION (INC.)

Director: Mr W. Vose

PROJECTS

Some properties of Waikiwi refractories. A method of measuring continuously the temperature distribution in a tunnel kiln setting. Chittering of salt-glazed pipes from Crum Brick, Tile, and Pottery Co., Auckland. Thermal expansion and porosities of field tile from Crum Brick, Tile, and Pottery Co., Auckland. Tests on down-draught kilns at Wairoa Brick and Pipe Works. Properties of Kamo Potteries Ltd. The dry-pressing of bricks at Huntly Brick and Fireclay Co. Ltd. The raw materials of the Huntly Brick and Fireclay Co. Ltd. An examination of the Hoffman Kiln at Wingatui Works of Fairfield Brick and Sand Ltd. The blending and mixing of wet clays and of wet with dry clays for the heavy clay industry. Some properties of refractories of the Huntly Brick and Fireclay Co. Ltd.

Methods of measuring particle sizes in 0–10 micron range; measurement of plasticity and workability; fundamental examination of fine structure of ceramic bodies unfired and fired and relation to the mass

properties; the development of improved fine refractory electrical insulating materials; the effect of pH upon the working properties of clays and their mixtures; the fouling of glazed surfaces in use, test methods and its prevention; suitable tests for impact, crazing and thermal shock resistance and surface contamination of vitrified hotelware; survey of raw materials in use or potentially useful in the heavy clay industry; the use of lower cost boron compounds in salt glazing; the design and preparation of test equipment for refractories; the determination of the properties of New-Zealand-made refractories; a study of the installation and deterioration of refractories in horizontal return tube boilers (in collaboration with D.S.I.R.); the survey of potential and actual production of structural clay products in New Zealand (their types and properties, the establishment of suitable tests and working standards); a critical survey of the use of mortars in masonry construction; and a study of the methods of construction using masonry in housing and commercial building.

PUBLICATIONS

Rapid Methods for Analysis of Soil, Clays and Other Silicates. *N.Z. J. Sci. Tech. B35*:433–9. M. Fieldes, L. D. Swindale, and J. P. Richardson, of Soil Bureau, and I. C. McDowall.

NEW ZEALAND WOOLLEN MILLS RESEARCH ASSOCIATION (INC.)

Director: Dr L. F. Story

PROJECTS

Pre-lamb shorn wool: continuance of comparative trials, and measurements of rate of growth of wool fibre when shorn at different times.

Survey of woollen carding.

Study of yarn irregularities.

Appraisement of wool obtained by a new method from skins.

PUBLICATION

Effect of Copper in Wool Dyeing. *Text. Mfgr., 79,* 654, and *Text. J. Aust. 29,* 18. L. F. Story.

RESEARCH INSTITUTE OF LAUNDERERS, DRYCLEANERS AND DYERS OF NEW ZEALAND (INC.)

Research Officer: Mr P. Carlyon Coates

PROJECTS

Survey of hospital laundry plants.

Investigation of causes of textile damage in articles processed in laundries and drycleaning plants.

Investigation into causes of stains and methods of removal.

Examination of serviceability of new fabrics in relation to laundering and drycleaning.

Quantitative measurement of efficiency in bleaching woollen fabrics.

GRANTS-IN-AID TO OTHER INSTITUTIONS

Grants for research in Universities and other institutions in 1953–54 were as follows:

	£	£
Auckland University College—		
Underwater research	650	
Seagrove Radio Research Station	4,000	
		4,650
National Institute of Oceanography (London)		5,000
Canterbury Agricultural College		6,000
Canterbury University College—		
Research on meteors	945	
Industrial Development Department	8,000	
Oceanographic research	800	
		9,745
Carter Observatory		1,900
Cawthron Institute		9,766
Commonwealth Agricultural Bureaux		17,554
Dr H. H. Allan (revision of Cheeseman's *Manual of New Zealand Flora*)		500
Massey Agricultural College		6,000
Royal Society of New Zealand		4,000
Victoria University College: Radio research		650
Incorporated research associations		37,144
Miscellaneous		152
		£103,061

Details of projects being conducted at some of the institutions receiving grants are shown below.

CAWTHRON INSTITUTE

Director: Sir Theodore Rigg

Aided by grants from the Department of Scientific and Industrial Research, work has been carried out on a wide range of problems connected with the tobacco, hop, fruit, and tomato industries of the Nelson district. Other important work has included entomological, soil, and plant-nutrition studies. In tobacco, hop, and entomological investigations the Institute collaborates with the Department of Scientific and Industrial Research in joint programmes—see under Secretary's Report and under Tobacco Research, Hop Research, and Entomological Research Station. Other projects are shown below.

PROJECTS

Soil Investigations.—Survey of molybdenum content of Nelson soils; survey of marginal hill country in Waimea County; influence of igneous outcrops on the alluvial soils of the Waimea County; and the analysis of a large number of soil samples from tobacco, hop, and tomato gardens in relation to unsatisfactory crops.

Plant-nutrition Investigations.—The main feature of the work in plant nutrition has been the study of minor elements in the nutrition of hops, tobacco, and pastures. Special attention has been paid to the

distribution of boron in hop plants, zinc content of hops, and molybdenum content of pastures, tobacco, and hops. The development of sugars and resins in hop cones is being studied.

Fruit Research.—Continuation of trace-element work with apples and raspberries; observations on magnesium deficiency; recording of yields on the apple-stock blocks at Annesbrook orchard; and the establishment of a raspberry garden at the Marsden research farm, Wakefield.

Tomato Investigations.—Work has continued on the effect of steam and soil disinfectants on the yield and quality of glasshouse tomatoes. Further tests of compost and cocoa husks used in conjunction with artificial fertilizers have been conducted, and studies of different factors that operate to produce low-quality tomatoes and physiological disorders of tomatoes have been continued.

PUBLICATIONS

New Zealand Ichneumonidae No. 3. Sub-family Ophioninae. *Trans. Roy. Soc. N.Z., 81.* A. W. Parrott.

Biochemical and Physical Changes in Tobacco Leaf during Flue-curing. *N.Z. J. Sci. Tech. B35:* 344–63. H. O. Askew, R. J. Monk, Joyce Hodgson, and G. Ward.

Nutrient Uptake by Glasshouse Tomato Plants. *Ibid. A35:* 127–34. E. B. Kidson, J. Watson, and L. Hodgson.

The Influence of Igneous Instrusions on the Magnesium Content of the Alluvial Soils of the Waimea County. *Ibid. B35:* 265–75. E. T. Chittenden and L. Hodgson.

Boron Deficiency and Uptake of Boron in the Hop Plant. *Ibid. A35:* 279–300. H. O. Askew and R. J. Monk.

"Cloud" or Vascular Browning in Tomatoes (Part III: Some Observations on Leaves and Fruit of Cloud-susceptible Plants). *Ibid. A35:* 368–74. E. B. Kidson and D. J. Stanton.

UNIVERSITY COLLEGES

CANTERBURY AGRICULTURAL COLLEGE

Director: Dr M. M. Burns

PROJECTS

Animal Husbandry Department.—Corriedale progeny test; and fat lamb sire trials.

Entomology Department.—Red clover pollination and seed setting; and the economic importance of cocksfoot thrips, *Chirothrips manicatus.*

Farm Machinery.—Small seeds harvesting.

Field Husbandry Department.—Pasture investigations on light land at Ashley Dene.

Microbiology Department.—Investigations on *Verticillium* infection of tomato; fertilizer treatments and *Rhizobium* bacteria—significance of bacteria in healthy clover tissues; and bacterial stains in wool fleece (in conjunction with Wool Department).

Soil Science Department.—Sulphur responses and interactions with other nutrients; molybdenum responses and interactions; and the use of fertilizers on herbage cut for conservation.

Lime research: a study of the rate of solution of South Island limestones in the soil in relation to fineness of grinding and physical properties; and a study on the rate of reaction and leaching of lime from the soil under Canterbury conditions following the application of ground limestone to pastures on various soil types on college lands.

Wool Department.—Fleece rot.

PUBLICATIONS

Phase Coloration in Lepidopterous Larvae. *Nature 172*:813. K. M. Doull.

Physiological Aspects of Some Bacteria Isolated from Clover Roots. *Proc. N.Z. Assn. Bacteriologists, 1953.* M. N. Crozier.

Recent Wheat Disease Problems. *N.Z. Wheat Review, 1950–51–52.* I. D. Blair.

Wool Quality and Fleece Weight. *N.Z. J. Sci. Tech. A34*:538. A. E. Henderson.

CANTERBURY COLLEGE INDUSTRIAL DEVELOPMENT DEPARTMENT

Director: Mr T. R. Pollard

This year has shown a further increase in the volume of work and in the financial returns; the increased cost of operation has meant a greater return for the work done. The number of projects handled for industry was 391, and 49 for Government departments. Recoveries for this period was approximately 30 per cent higher than the previous period.

Lack of space is having a serious effect on economical working, and for this reason work in the metallurgical field cannot be increased.

Non-destructive testing has increased again, and this department has been training personnel from the various Transport Boards in the simpler methods of dye penetrant work. Dynamic balancing also has increased considerably, and some 30 crankshafts have been balanced. The dynamic balancing of the 15,000 kW. synchronous condenser was carried out at Hororata for the State Hydro-electric Department in the field, since the rotor weighed approximately 20 tons.

The automatic machine for the edge grinding and polishing of glass has been completed and has been in successful operation for some months. Development and design have been carried out on low-voltage high current heating of platens using stainless steel sheet, and in commercial use is proving very economical. A completely automatic machine for the edge bevelling of various shaped mirrors is being designed in which some servo-mechanism work is involved. A servo-mechanism control has been developed and made for the Fats Research Laboratory, and has proved most satisfactory in operation. A second electronic stimulator for non-convulsive therapy has been completed, has been in operation for some months at Seacliff Mental Hospital, and will be used for research. This instrument supplies both positive and negative going pulses of variable frequencies, variable widths, and variable amplitudes. An X-ray diffraction goniometer has been made for the Chemistry Department.

MASSEY AGRICULTURAL COLLEGE

Principal: Professor G. S. PEREN

LIST OF PROJECTS

Sheep's Teeth.—The cause of abnormal rate of wear.

Genetics of Romney Sheep.—Mendelian relationships; and genetic correlation between hairiness and thrift, together with carcass.

Drainage Research.—Investigation of a number of problems each connected with mole drainage, tile drainage, and farm drainage.

Pampas Research.—Improvement by breeding and selection, together With a study of manuring and general management.

Manurial.—Trials under rotational grazing.

Sheep Breeding.—Experiment on the heritability of important characteristics of the Romney breed.

Sheep Parasitology.—Investigation of inhibition of parasitism in sheep by grazing on various pasture plants grown in pure stand; and the epidemiology of round worm parasitism in sheep.

Plants.—Propagation and toxicity studies.

PUBLICATIONS

Photographic Chart of Wear in Sheep's Teeth. Published by Massey Agricultural College. C. R. Barnicoat.

Mole Drainage Investigations in New Zealand. *N.Z. J. Sci. Tech. A35*: 237–48. H. G. Hopewell.

Tile Drainage Investigations in New Zealand. *Ibid. A35*:249–61. H. G. Hopewell.

Advantages and Disadvantages of Crossbreeding Sheep in New Zealand. *Proc. M.A.C. Ann. Mtg. Sheepfarmers 1953.* A. L. Rae.

The Prospects of Fleece Improvement by Breeding. *Wool 2*:29–31. A. L. Rae.

Control of Docks by Hormones. *Proc. N.Z. Weed Control Conf. 1953.* J. K. Templeton.

Inhibition of Populations of *Haemonchus contortus* in Sheep Fed on White Clover (*Trifolium repens*) High in Lotaustralin. *Nature 171*:311. J. H. Tetley.

The Propagation of *Camellia reticulata.* Roy. Hort. Soc. (Nov. 1953). J. S. Yeates.

Polythene Plastic as an Aid in Grafting Evergreens. *Ibid.* J. S. Yeates.

Experience With New Herbicides: Maleic Hydrazide. *Proc. Weed Control Conf. 1953.* J. S. Yeates.

SEAGROVE RADIO RESEARCH STATION, AUCKLAND UNIVERSITY COLLEGE

Officer in Charge: Dr H. WHALE

PROJECTS

Rotating Radio Interferometer.—The recording, simultaneously from six stations, of the angles of arrival of radio transmissions.

Automatic-recording Direction-finder.—Investigations into the short-period changes in the bearing of radio waves received via the ionosphere.

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